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# Motorship

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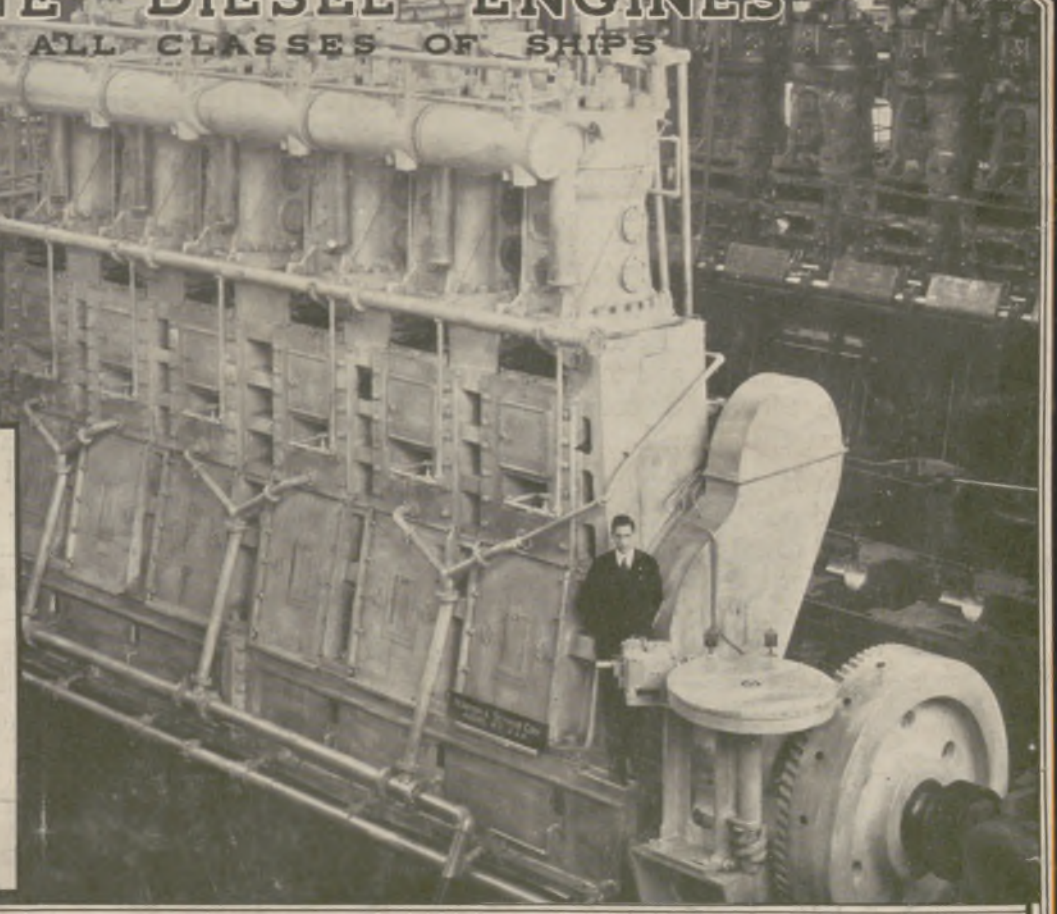
SEPTEMBER, 1924

MARINE DIESEL ENGINES
FOR ALL CLASSES OF SHIPS

THE Four Seagoing Hopper Dredges for the Engineer Corps of the United States Army are each equipped with three 1000 H.P. and two 225 H.P. McIntosh & Seymour Diesel Engines, making a total of 14,000 H.P. in these four ships.



McINTOSH & SEYMOUR CORPORATION
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*EXCLUSIVE technical and non-technical articles on design, construction and operation of oil-engines and motorships by the world's foremost writers on marine engineering.*

# Motorship

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*PROFUSELY illustrated with photographic reproductions of the newest designs in international merchant motorship and Diesel-engine construction and auxiliary equipment.*

Vol. IX — New York, U. S. A., September, 1924 — No. 9

(Cable Address—Motorship, New York)

# Double-Acting Diesels Will Be Included in First Twelve Ship Installations

*Higher Power and Speed Now Required by Operators Has Caused Shipping Board to Change Original Plans. Another Modification Also Recommended*

FOR the past few weeks the Department of Maintenance and Repair has been working with all possible speed on the ship conversion program. Although a recent decision by the Shipping Board to permit consideration of incorporating some double-acting Diesel installations has provided additional work and problems, good progress has been made by the Department under Captain R. D. Gatewood and specifications will probably have been issued by the time this is in print with bids to be called two weeks later.

Replies of the operators such as the Dollar, Admiral, Kerr, Munson, Barber and Tampa Interocean Lines on the questionnaire issued by the Board ask for a range of speeds from 10½ to 14 knots. But, high speeds are out of the question owing to the hull forms and the machinery space available, and an average of 11½ knots is the best which can be economically obtained under the circumstances. Perusal of a summary of the answers to the questionnaire has given us the impression that most of the operators are accustomed to operating large cargo steamers and have the feeling that for a ship to average 11 or 11½ knots over a long period of operation she must be what is known as a 12-knot boat. And, that they are not accustomed to having a 11½-knot vessel average 11½ knots year in and year out without excess power, as is the case with a well-built modern motorship.

Two of the operators have recommended 12,000-ton hulls, but the Board has decided not to include the eleven available craft of this size in the first batch of twelve ships. Six Oscar Daniel (No. 1027) built 9,500-ton hulls, and six or more of the twenty-seven Los Angeles Shipbuilding Co.'s 8,500-ton boats (No. 1013) have been tentatively selected by the Board for the initial conversions.

It is hoped that it be found possible to install single-screw Diesel engines of approximately 3,000-s.h.p. at normal r.p.m. in these vessels, and bids will be asked of six to eight manufacturers and this power gives a sea-speed of 11¼ to 11½ knots loaded. While double-acting engines possibly may be installed in some of them, bids will only be considered from such firms who have actually built and tested at least a single-cylinder oil-engine of this design including the Worthington Company, with the possible inclusion of the Cramp Shipyard because of their own single-acting Diesel experience and the double-acting development work already carried out by the licensors, Burmeister & Wain. The question has been raised if the New London Ship & Engine Co. are not also eligible under this ruling, as not only have they constructed and tested both two-cycle double-acting and four-cycle double-acting Diesel cylinders, but have available the extensive double-acting experiences of their licensors, the M. A. N. Doubtless every phase of their position and of others will be given proper consideration by the Board.

General consensus of opinion current in shipping circles is that less criticism would probably result and greater encouragement would be given to oil-engine builders if the Board increased its first batch of conversions to fifteen ships and included three double-acting drives, and at least one reduction-geared drive and one electric drive. Better all-round satisfaction would result, and much beneficial impetus would be produced tending to give at once to the American merchant marine the very latest examples of motorships. While we have due sympathy for the conservative policy of the Board in its desire to proceed cautiously in the spending of the nation's money and to avoid repetition of mistakes of the past, there is such a thing as ultra-conservatism blocking of desirable progress. Our desire is to assist and not embarrass the Board, but from our observation post of vantage it is obvious to us that in a modification of their plans along these lines the Board would show wisdom and tact as well as due consideration to those responsible American companies who have spent large sums of money in developing machinery calculated to equip our ships with an All-American version of the most modern, the most efficient and the most economical type of power plant, in accordance with the spirit of the Jones Act and its amendment. Doubtless the Board will be guided by the sentiment now being expressed in the shipping and engineering circles, which must shortly become felt both in Washington and in New York. That the Board's policies are amenable to constructive changes is indicated by the decision to include double-acting Diesels.

## Motorship Supplement Will Appear October 1

IN order to permit the completion of the data now being prepared by Shipping Board officials, we have been requested to release the Conversion and Construction Supplement with our October issue, instead of our September issue, as originally planned, and in the interests of completeness and accuracy this step has been taken.

THE October issue is expected to be the largest publication which has been produced by MOTORSHIP, as the combined issue and Conversion section will have a total of approximately 225 pages.

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# Ford's Two 611-ft. Motorships Placed in Service

*Single-Screw Vessels With Sun-Doxford Diesel Engines May Break All Operating Economy Records on the Great Lakes*

WHEN Henry Ford undertakes anything it is a foregone conclusion that it is going to be done right. Halfway measures are not in this remarkable man's vocabulary. No matter whether he tackles "flivvers," railroad systems, or iron mining and transportation he attends to the job so thoroughly that not the slightest detail is overlooked.

This applies with particular force to the 13,000-ton, ore-carrying motorships BENSON FORD and HENRY FORD II, both of which have just run trials, and been commissioned by the Ford Motor Company of Detroit. These boats represent the very last word in lake vessel construction, not only as regards hull and fittings, but also as regards the type of power plant which has been chosen. This consists of a 3,000 s.h.p., four-cylinder, two-cycle, opposed-piston Sun-Doxford oil-engine—the biggest thing of its kind which has been commissioned on the Great Lakes and one of the largest marine oil-engine power plants which have been put in operation by any United States shipping interests.

It is well known that the Ford Motor Company has extended its operation from the manufacture of automobiles to include the mining and smelting of the iron ore needed for this industry, and in order to secure the greatest possible business economies in all branches of these vast undertakings the railroad and ship transportation systems necessary for it have also been acquired. The various Ford enterprises are becoming one vast industrial unit complete in itself.

Coal and ore necessary for operating the blast furnaces of the Ford Motor Company will be transported by these new motorships, a fact which puts the economies and operating advantages of the oil-burning internal-combustion engine into particular sharp relief. It would seem natural and self-evident that a ship which transports coal and coke anyway could advantageously use a part of its cargo for the supply of its propelling plant, but so important are the economies capable of being effected by the oil-engines that it makes good even in the face of such competition as this.

Lake shipowners plugging along the same way as they have done for years shake their heads and say "It can't be done." But undoubtedly Henry Ford, as he has done in many other cases, will show that it can be done—and done with ships so elaborately and splendidly equipped that their cost is a million and a half dollars each, or 'way beyond the price of any coal-burning lake freighter ever built. To show the foresight of his brilliant mind, and the reason why everything he touches turns to gold, he is already making arrangements to use as fuel the waste oil from his blast furnace at River Rouge.

Located far aft, almost in the stern peaks of the two ships, are the two 3,000-s.h.p. Diesel engines rated to develop their power at 85 r.p.m. All auxiliaries, both for the engine-room and deck, are electrically driven with current supplied from two Worthington six-cylinder, two-cycle, airless-injection oil-engines developing 450 shaft h.p. at 275 r.p.m. This equipment, of course, is the heart of the ship and its characteristics largely determine the general nature of these unique vessels.

The "Benson Ford," one of the two 611 ft. single-screw motorships propelled by 3,000 s.h.p. Sun-Doxford Diesel engines and owned by the Ford Motor Company of Detroit. These boats are expected to make history on the lakes

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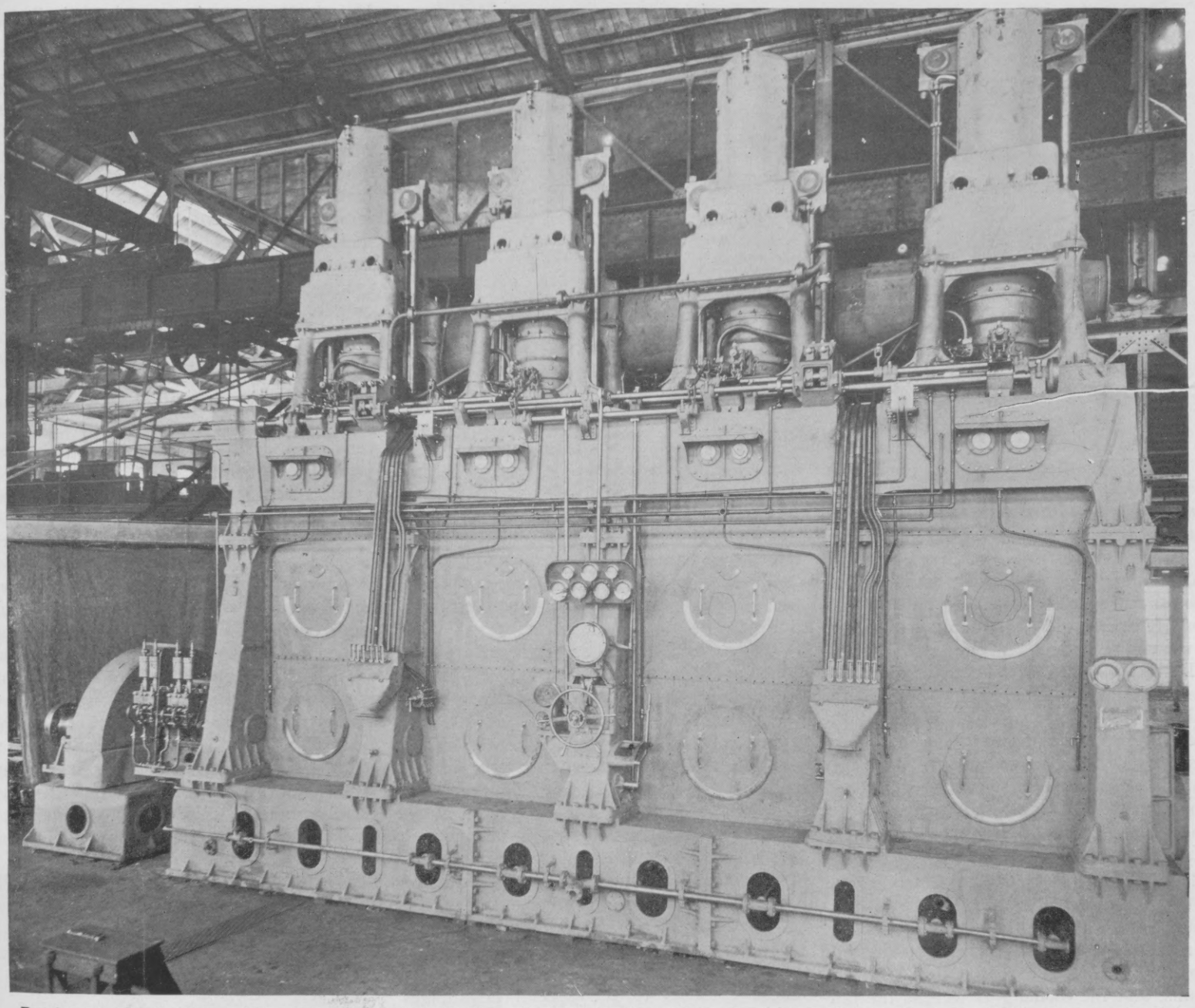

By the use of two pistons in each cylinder of the Ford motorships' engines, 3,200 s.h.p. can be developed on practically the same length as that of a triple-expansion steam engine of the same power

One built to the American Bureau's rules and the other according to Lloyd's highest classification, these characteristic lake freighters have all the external appearance which makes them such picturesque elements of Great Lakes panoramas. Long, thin, snakelike, they are dimensioned just to pass through the existing locks and canals, and it would surprise the uninitiated to know with what extremely small clearances these spearlike vessels pass through the locks. Such service as this naturally demands the utmost from the propelling units in the way of reliability in maneuvering, and the adoption of oil-engines is just one more of the countless proofs that the oil-engine is second to none in the precision with which it can be operated.

Characteristic of Lake vessels is the arch construction, which is more or less inseparable from the necessity of accommodating the required tonnage in hulls of such extreme lengths.

Measuring 611 feet overall, the BENSON FORD and HENRY FORD II compare favorably as regards length with some of the biggest ocean-going tonnage afloat, although their displacement amounts to only 13,000 tons. The BENSON FORD was built by the Great Lakes Shipbuilding Company and the HENRY FORD II by the American Shipbuilding Company under the personal supervision of W. R. Mayo, chief engineer of the Ford Motor Company.

The dimensions of the vessels are as follows:

| | |
|---|---|
| Length overall | 611′ 0″ |
| Length between perpendiculars | 590′ 0″ |
| Breadth, moulded | 62′ 0″ |
| Depth | 32′ 0″ |
| Dead-rise of section | 3″ |
| Bilge-curve radius | 3′ 3″ |
| Tumble-home of side | 12″ |
| Deck camber in 60 feet | 15″ |

W. B. Mayo, Chief Engineer of the Ford Motor Company, seated in the foreground. Next to him is George B. Turnbull of the Great Lakes Engineering Works

The fact that a structure of this kind would be subject to severe bending stresses if special provisions were not made to counteract them explains a number of the features which make these vessels contrast in so marked a degree with the commoner forms of salt-water ships. Resistance to bending is, of course, the primary consideration. By carrying the tank top clear across from one ship's side to the other and eliminating bilge wells, a great deal of strength is imparted to the bottoms and in addition to that the ship's sides are very effectively reinforced by side tanks running almost from stem to stern. As much strength as possible is given to the spar deck by the use of heavy beams and channels located as close together as is practical in view of the openings necessary for the hatches, of which are are eighteen, measuring 40′ athwartships and 12′ fore and aft

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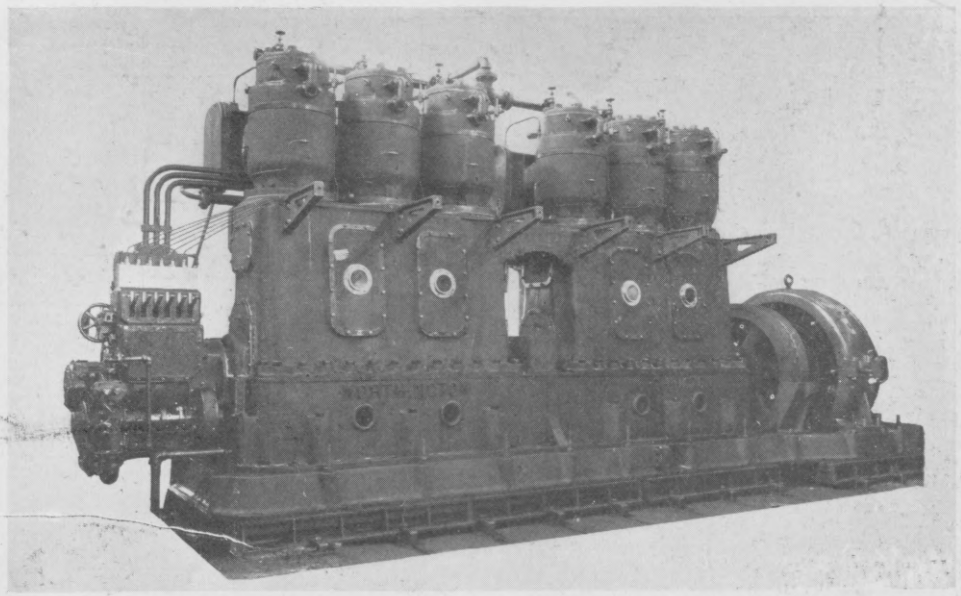


Worthington 450 b.h.p. auxiliary oil engine has no exterior moving parts

Twelve feet of plated deck remains between hatches and the resulting arrangement fits in perfectly with the increased working radius found on present-day unloading machines. A special form of arch construction aft enables pillars to be dispensed with in the engine room.

Delightful trips can be made on Lake freighters and the unusual beauty of the Lake country can be well observed from the decks of these spacious craft, a fact which has been duly taken account of by Henry Ford in providing luxurious owner's accommodations on his new motorships — finer than are to be found in private suites on ocean liners.

Designed by Arthur Keil, a Detroit architect, the interior decorations of the owner's stateroom and living rooms are distinctive. For use as a baseboard and for radiator tops, marble has been used in some of the rooms, and the owner's as well as the officers' bathrooms are tiled with handsome bronze doors to the showers. Electric fixtures of unusually attractive and original design have been provided throughout and white oak, English oak, walnut and mahogany are applied either in the ceiled or panelled form; inlay work and painted decorations being used to good advantage. All closets are cedar lined.

In accordance with the most modern motorship practice, as has already been mentioned, all auxiliaries are electrically driven. The most vital of these is naturally the steering engine, the one on the Henry Ford II being of the spring quadrant type, equipped with duplicate Benson Electric Company control. The Westinghouse motors running at 475 r.p.m. and rated to develop 50 h.p. are geared up to a large spring quadrant on the rudder post in the usual manner. The reason for having two motors is that in case either one of them should be disabled for any cause the other is at once ready to be thrown in—an unusual safety provision. It is particularly interesting to note that in case of such an emergency the duplicate Benson Electric control permits the pilot to shift from one motor to the other without sending a man aft.

Few people who have not been aboard these ships realize what it means to be steering one of these 600-foot dachshounds from the bow and to have something happen to the steering gear more than one-tenth of a mile in the rear. Long before anybody could go back aft to ascertain the trouble or to apply remedial measures, locks would be smashed and incalculable damage done.

Steering the Benson Ford is done by means of electro-hydraulic gear furnished by the Hyde Windlass Company jointly with the American Engineering Company. Power for operating the oil pumps is delivered by two Westinghouse marine-type electric motors and duplicate Benson Electric control from the pilot house permits of shifting from one to the other as in the case of the Henry Ford II. A 50-h.p. Crocker-Wheeler motor operates the windlass.

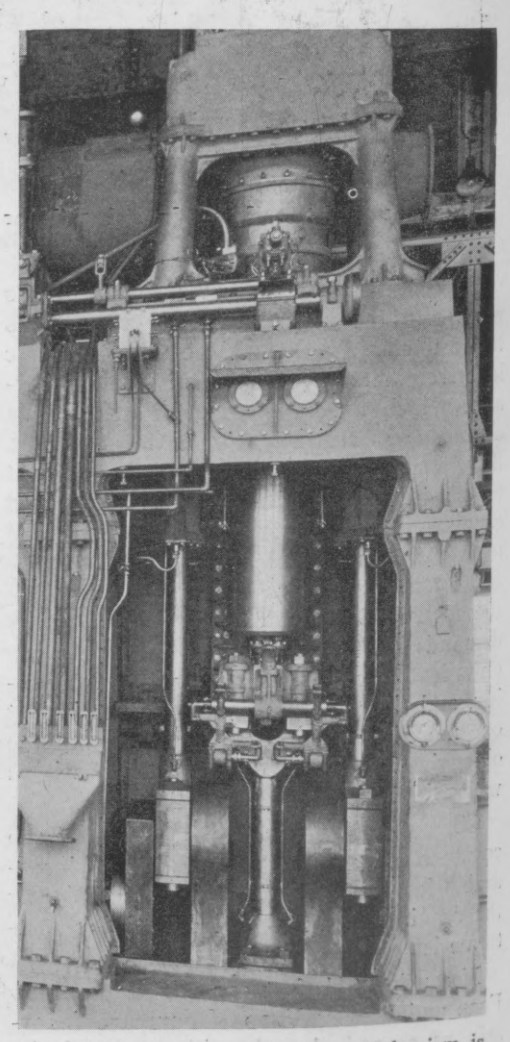
Reference has previously been made in these columns to the special advantages which the use of electric-driven mooring winches of the automatic tension type have to offer. Attention needs hardly be called to the fact that a ship over 600 feet in length would require very considerable amounts of labor to keep it properly moored while loading or unloading is going on. Incredible loading and discharging speeds are attained, with the result that the hull rises and falls very quickly as it is being emptied or filled.

Changing hawsers by hand to accommodate this would require so much labor as to be impractical and the use of automatic tension system in connection with steam winches is, of course, enormously wasteful. Steam lines 600 or more feet in length leading from the engine room aft to mooring winches forward alone waste an amount of steam several times as great as the actual demand by the winch, and in view of the fact that the winch is practically stationary during the greater part of the time when it is being used for the automatic mooring service further great losses in power result.

In view of these facts the perfection of electric mooring winches such as those designed and built by the Lidgerwood Manufacturing Company for automatic tension service are of great importance and are bound to attract the attention of all those concerned with the economical handling of ships.

As a primary requisite for a mooring winch may be mentioned an electric motor of sturdy characteristics such as that furnished by the Electro-Dynamic Company. The motors built by this company have steel castings of an unusually rugged design, as is readily apparent from the illustrations which accompany this article. Both their construction and the use of steel for the castings makes them so rigid that no gaskets or packing material need be used between the faces. Water-tightness is assured simply by the accuracy and rigidity with which the two halves are bolted together and by the fact that all packing materials are dispensed with. Packings of any kind are subject to renewal and are frequently damaged when joints are open.

All these troubles and annoyances are completely avoided in the design of the Electro-Dynamic motors. Water-tightness around the shaft-end through which motion is communicated to the winches is also secured without the use of packing of any kind, a simple labyrinth having been machined into the end casings. Since the latter are self-draining the entrance of water into the interior of the motor is completely prevented without the use of packings at this point also. In order to be effective a labyrinth must be fitted with reasonably close clearances which are less than can be practicably employed if sleeve bearings are used. Such bearings inevitably wear down and



Simplicity of opposed-piston mechanism is clearly shown by this view

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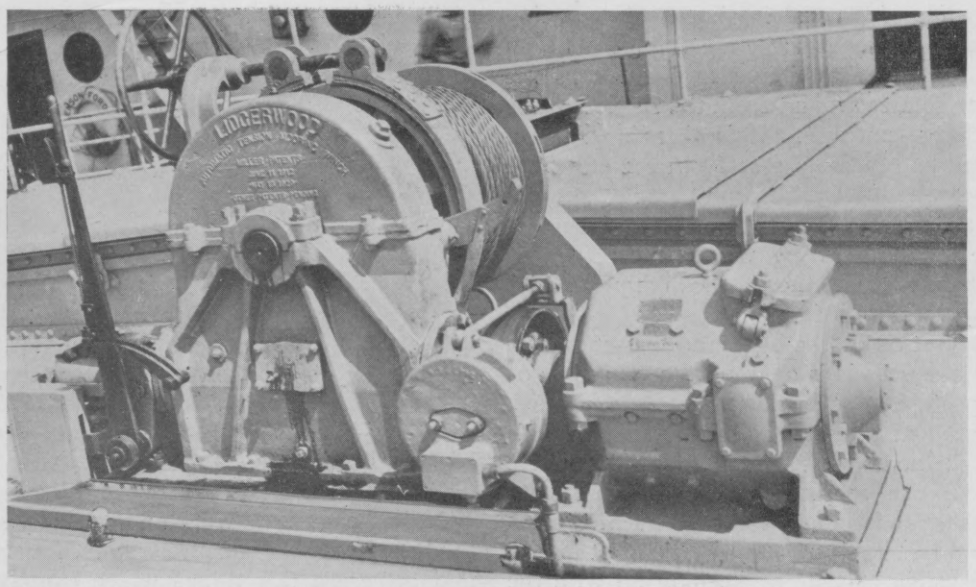
unless the labyrinth clearance is sufficient to take care of it cutting of the shaft will result. But in the design under consideration this difficulty has been side-tracked by the use of short roller or ball bearings whose wear-down is so slight as to be altogether negligible. They are very short and permit the labyrinth to be made with a series of chambers without unduly lengthening that part of the end covers which project away from the motors. These and many other features are responsible for the adoption of Electro-Dynamic motors in connection with the automatic mooring winches. The winches themselves—as stated—are Lidgerwood products and have incorporated all the advantages of steam drive as well as some extra ones besides.

Maintenance of any constant tension on the hawser is secured by means of a graduated switch set for any desired strain by the operator. A heavy-coiled spring backing up the thrust bearing of a wormshaft yields according to the strains imposed upon it and suitably actuates the electrical control. If the ship is unloading and consequently rising out of the water there will naturally be a tendency for the hawsers to hold it back, and if no means were provided for slacking them off they would snap.

As the result of the slight endwise motion imparted to the wormshaft by this action the electrical control releases the winch brake until enough of the hawser has been played out to bring the strain back to the original amount, at which time the brake is again locked. Conversely, if the ship is being loaded and settling down in the water so that there would be a tendency to slack away at the hawser the wormshaft moves endwise in the opposite direction suitably actuating the electrical controls to bring back the tension to the amount determined by the operator's setting. There is nothing in this arrangement which prevents the winch from being used in the normal manner, manual or automatic control being secured by the simple operation of throwing a latch one way or the other.




This winch automatically hauls in and plays out the mooring cable in such a way that a constant tension is maintained witout attention from the deck force

As a result of these arrangements it is possible for the crew to leave the mooring winches entirely alone while loading or unloading, and their construction is so sturdy that dangers from breakage or interruptions in their functioning due to any other causes are practically ruled out.

It would lead us too far a-field to discuss in detail all the up-to-date refinements and improvements embodied in the deck and navigating equipment of these remarkable motorships, and we find it necessary to limit ourselves to a consideration only of the more unusual ones. Outstanding among these is the Sperry gyro-compass, which consists of a master compass located on the main deck forward and operating dial indicators at various points on the bridge and other parts of the ship.

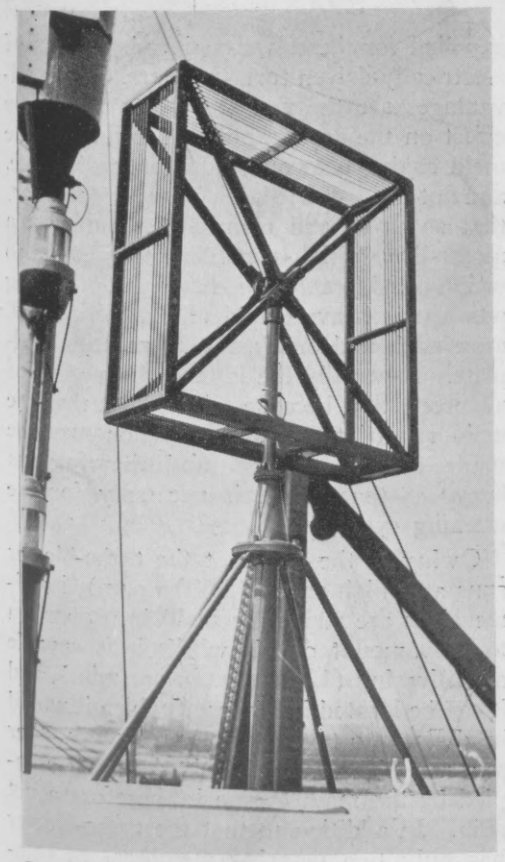
Here is another feature which salt-water shipping men are not so likely to have noticed, and that is the fact that large submarine deposits of iron ore occurring in the bottoms of the Great Lakes have been known to seriously disturb the indications of magnetic compasses. Naturally, the gyro compass is entirely immune to these effects, depending as it does entirely upon the dynamic effect of the earth's rotation.

The fundamental principle of these instruments is of the most elementary simplicity and depends only on the fact that any body rotating at a high speed and mounted in such a way as to be capable of setting its axis at all possible angles will automatically assume a position in which its center line is parallel to the earth's axis. The precision resulting from this method of indicating a ship's course is so great that it results in material savings of mileage and consequently of fuel in comparison with the usual inaccurate magnetic compass.

Other highly modern instruments supplied by the Sperry Gyroscope Company consist of a rudder indicator for showing the wheelsman at all times at what angle the helm may be standing, a revolution counter for the main engine, a direction indicator to show which way the propeller is rotating, and a course recorder. An Electro-Dynamic helm-angle indicator is fitted on one of the ships. The cost involved in these modern refinements is only a small fraction of the savings made possible by their use. To mention only a few of them, a direction indicator for the main engine is a valuable safeguard against confusion of signals, particularly in view of the extreme length of the ship and the difficulty of rectifying any errors in case of mistakes arising out of the use of the ordinary engine-room telegraph. In maneuvering through locks and some of the confined waters which are met with in Lake navigation these safeguards are cheap insurance against expensive mishaps.

An 18″ high intensity searchlight, also supplied by the Sperry Gyroscope Company, further insures the safety of passing through narrow waters at night time. Another modern navigation instrument is the Kolster radio compass for obtaining bearing under any weather conditions.

What has been said of the up-to-date and modern equipment of these ships applies equally to the arrangement of the crew's quarters and the sanitary and domestic appliances. Each officer's cabin has its own private tiled bath. As a safeguard against polluting the waters of canals and confined harbors sewage is not discharged directly overboard, but is taken care of by means of two 700-gallon tanks. Soil pipes leading from the tanks and cabins above enter the sewage tanks through automatic check-valves and the capacity of the system is such that the ship can be berthed for several days before it becomes necessary to dispose of the contents of the tanks. This is done by means of air-pressure at 20 pounds per square inch supplied from Nash motor-driven rotary compressors. The latter are of the hydraulic rotary type and effect a compression of air by means of a centrifu-



Loop antenna for radio compass on the "Benson Ford"

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gal water-ring revolving in an oblong casing in such a way that the air volume between the blades of the impeller changes as the latter rotates around from the suction to the discharge opening. It is therefore water-sealed and entirely free from the clearance losses which play a certain part in mechanical rotary compressors; and the cooling effect of the rotating water-ring results in isothermal and therefore highly efficient compression of the air.

Operation of the bilge and ballast system on Lake vessels is of importance in view of the necessity for making quick turn-arounds. Because of the modern loading and unloading methods used at the ore docks these vessels are operated on very quick turn-arounds and the advantage incident thereto would be largely lost unless a ballast pumping system capable of keeping up with the unloading devices were not provided. Accordingly, the two Ford ships are equipped with duplicate ballast pumps of unusually high capacity which are capable of handling the ballast water for the entire ship, amounting to 7,390 short tons, in less than three hours. There are two 7,000 g.p.m. Union double-suction centrifugal pumps, connected to manifolds conveniently located along the forward engine-room bulkhead. Each of them is driven by a 75 h.p. Crocker-Wheeler motor. For drying out the ballast tanks there are two more auxiliary ballast pumps, and two Nash Company's Hytor No. 3 positive-vacuum rotary priming pumps have been provided. Since they are capable of maintaining a 20-inch vacuum, no matter how much air there may be in the suction line, they can also be used for keeping the suctions of the main ballast pumps continuously primed.

It would also require many pages to describe the interesting features of the piping system which is fully controlled by means of Jenkins valves. Many types of the latter are used and all of them have been selected from the wide range of stock available, in view of their special adaptability for the service in which they are used. It would surprise the layman to see the enormous quantity of valves which are used on any ship as the piping system is being installed; day after day the crane discharges hoppers full of them into the hold while the ship is being fitted out, and when the job is done it is sometimes difficult to tell where they have all gone to. Ninety per cent of the operating engineers' work on board any ship is devoted to the manipulation of valves, and there are few things which contribute so much to the smoothness of a ship's operation as care and judgment in the selection of its valve equipment. Valve manufacturers in the past have not appeared to pay special attention to the motorship industry as distinct from shipbuilding in general. With most Diesel driven craft only high grade valves are used.

Bow view of the "Benson Ford" in the Davis lock at Sault Ste. Marie, Mich.

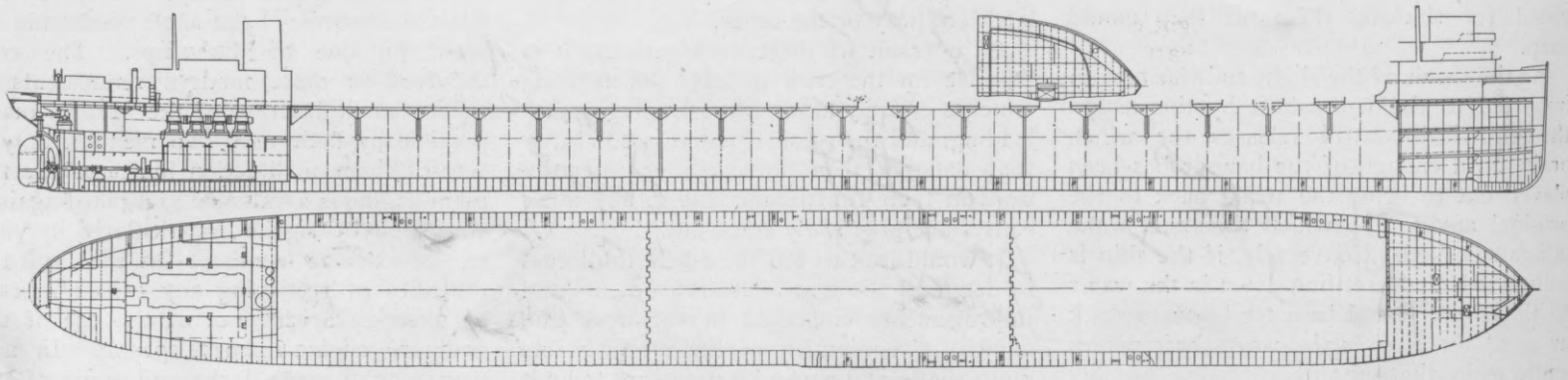
It is interesting also to note in passing that no fewer than 65 Crocker-Wheeler electric motors, aggregating more than 800 h.p., have been used on these ships. Although not quite that many motors will be required on the ships which are shortly to be converted to Diesel power by the Shipping Board, there can be no doubt that each one of these jobs will require 40 electric motors averaging 12 or more horsepower at the very least.

There have been many occasions to describe the opposed-piston, two-cycle engine of the type and cylinder size used on these ships. Readers of Motorship will recollect the Bidwell, Miller County, and Challenger, all of which are driven by the Sun Shipbuilding Company's engines built according to the Doxford design. W. B. Mayo, chief engineer of the Ford Motor Company, made a close study of the Sun Company's product before choosing them as the motive power for the big Ford Lake vessels. On the trial trips the engines ran smoothly and without vibration.

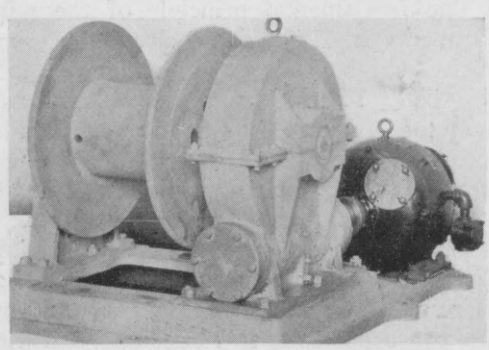
As regards the main constructive features of these engines, they differ in no important respect from those of the engines installed in the ships above referred to. The framing, to be sure, has been altered in that the new engine has only one set of columns astride of each main bearing, whereas the older design was put together out of separate and independent cylinder units, each one having its own frame structure. As the result of this change a very considerable saving in weight has been effected and a closer-knit design has been produced.

More striking yet is the elimination of the reciprocating scavenging-pump, formerly located between the two center cylinders. In accordance with the most modern and approved practice, scavenging air is supplied for these two engines by means of electrically-driven turbo-blowers. Many advantages are the result of their use. The effect on the appearance and weight of the main engine is at once apparent to the eye, and not much reflection is necessary to show that so small and compact an outfit as a motor-driven high-speed blower is bound to weigh considerably less than a reciprocating pump with heavy cylinders, connecting-rod, crosshead, and crank, not to mention bedplate. Especially the latter is heavy out of all proportion because of the fact that the main run of the bedplate section must be made continuous with and therefore as heavy as that which is necessary for the working cylinders.

Owing to the fact that the turbo-blower runs at a high speed (3,600 r.p.m.), its dimensions are strikingly small in proportion to the amount of air which it is capable of delivering (12,000 cu. ft. per min.), and it can be located in spaces of which it would be difficult to take advantage for any other purpose. The gain made in the room occupied by the main engine is therefore a net gain. In addition to that the turbo-blower has only two working members, as compared to reciprocating parts, valves and the



Plans of Ford motorships show extremely slender construction characteristic of Lake practice. Note small amount of space occupied by opposed-piston oil engines



Motorized deck auxiliaries on Ford ships are of simple, sturdy construction

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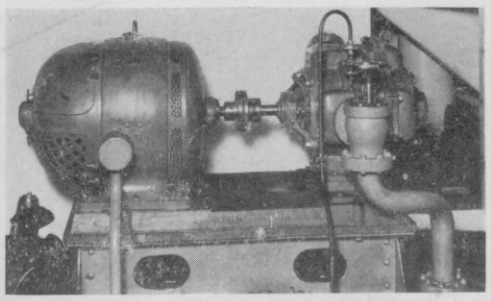
like which encumber a direct-driven blowing engine.

PARTICULARS OF SUN-DOXFORD ENGINES

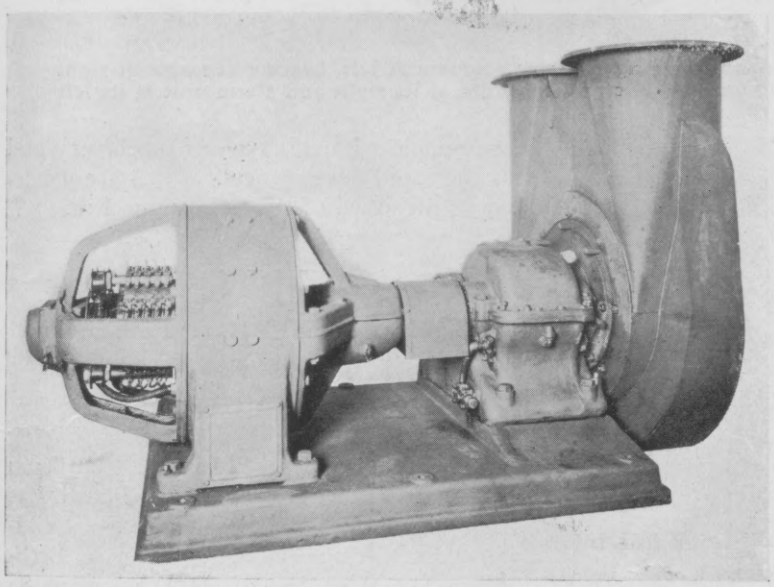
| | |
|---|---|
| Power, at 90 r.p.m. | 3,200 s.h.p. |
| Power, at 85 r.p.m. | 3,000 s.h.p. |
| Number of cylinders | 4 |
| Number of pistons | 8 |
| Number of main bearings | 6 |
| Number of crank-pins | 12 |
| Bore | 23½ inches |
| Total stroke | 7 ft. 7 " |
| Crank throw | 22¾ " |
| All crank pin diameters | 18.11 " |
| All journal diameters | 16.92 " |
| Length, outside pins | 10.89 " |
| Length, center pins | 20.86 " |
| Length, journals | 14.96 " |
| Piston clearance at d.c. | 9.44 " |
| Mean eff. pressure | 94 lbs. per sq. in. |
| Firing order | 1-3-2-4 |

One of the interesting consequences of the use of an independently-driven turbo-

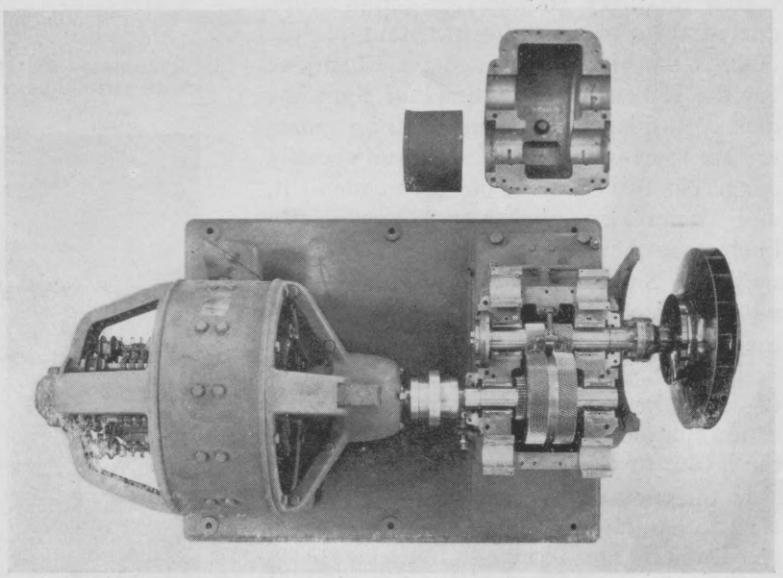


The Hytor Vacuum pump and its semi-enclosed Crocker-Wheeler motor

through them and it becomes difficult to supply enough air to maintain steady running at the lowest speeds if a direct-driven pump is used. Such a one still makes the same number of strokes in proportion to the number of port openings, but the longer duration of the latter quickly uses up the supply. The circumstances are different if the air comes from a supply independent of they would consume an amount of power aqual approximately to 6 per cent of that developed by the main engine. However, even if the main engine were to be run at 3,200 h.p. and if we adopt the conventional figure of 3½ cu. ft. of free air per horsepower per minute necessary for a two-cycle engine, only 11,200 cu. ft. per minute would have to be delivered by the blower, whose power consumption rating of 180 h.p. is based on 12,000 cu. ft. per min. Moreover, this delivery is made against a pressure of 2 lbs. per sq. in., whereas 1½ lbs. are amply sufficient for the easily-scavenged uniflow cylinders. It is therefore safe to say that the power required by either of the blowers (one of them is held in reserve as a spare) will come under 5 per cent of the main engine output. In order to avoid the use of an excessively high-speed motor a herring-bone step-up gear with a ratio of 3.27:1 is



Compact General Electric turbo scavenging unit replaces bulky reciprocating pumps on the main engine of both the motorships "Benson Ford" and "Henry Ford II." A spare set is installed

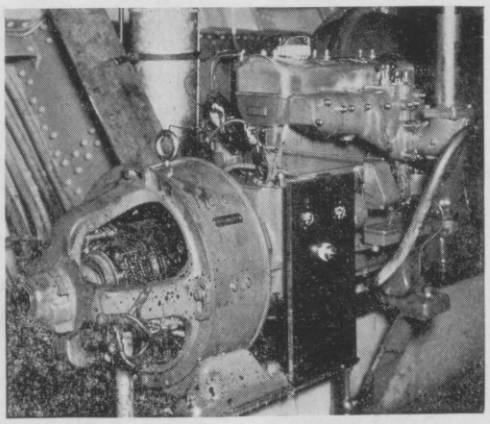


Speed gear in turbo blower design permits the use of a normally-designed motor running at 1,100 r.p.m. while the rotor has a speed of 3,600 r.p.m. and delivers air at 2 lbs.

blower is that it has the net effect of making a part of the power furnished by the auxiliary engines available on the propeller shaft. The 5 per cent or so of main engine work which would ordinarily be required to drive the scavenging pumps now represents just that much extra work transmitted to the propeller and the difference is made good by the auxiliary engines. It should not be overlooked that the load-factor on the auxiliaries is thereby considerably improved and their economy both as regards fuel consumption and investment cost is increased. Whereas they furnish power while at sea mainly to the scavenging blowers, they are used for operating winches and ballast pumps during the greater part of the time spent in port.

Much could still be added about the advantage of the turbo-blower, but in concluding this subject we call attention to the way in which it improves the maneuvering of the main engine. Obviously, when the latter is running at reduced speed, the pistons allow the scavenging and exhaust ports to remain open longer; more air blows tne engine. The motor-driven blower is still giving the engine as much air as it was getting at full load and speed and can even be accelerated if necessary.

Both the blowers and the motors and speed-up gears necessary for driving them have been furnished as integral units by the General Electric Company. As each of the motors is rated at 1,100 r.p.m. and 180 h.p.,



The Hall-Scott-Delco emergency generator set in the engine-room of the "Benson Ford"

shunted in between the electric motor and the turbo impeller.

As has been remarked, the power used for the blower represents a net increase in the power available on the propeller shaft and its source is a pair of Worthington airless-injection oil engines consisting of six two-cycle cylinders each and direct connected to Crocker-Wheeler electric generators. Whereas the engines are rated at 450 h.p., the output of the generators is 300 kw. at 275 r.p.m. The latter are provided with interpoles and are wound with such characteristics as to make them capable of being paralleled without difficulty. Water-proofing is used for all the insulation in accordance with the most rigorous demands of marine service.

No injection air is necessary for running the Worthington engines and their operation is the simplest possible. Since crossheads are fitted, it is possible to use the under-side of the working piston as an effective scavenging pump, and the force-feed lubrication system is completely sealed off against the contamination which would

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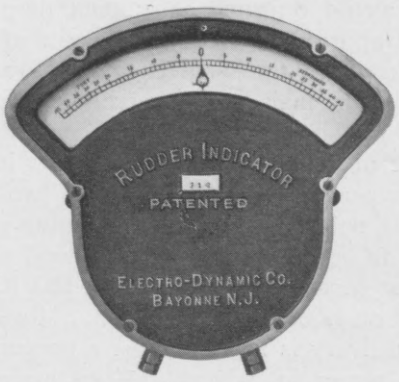


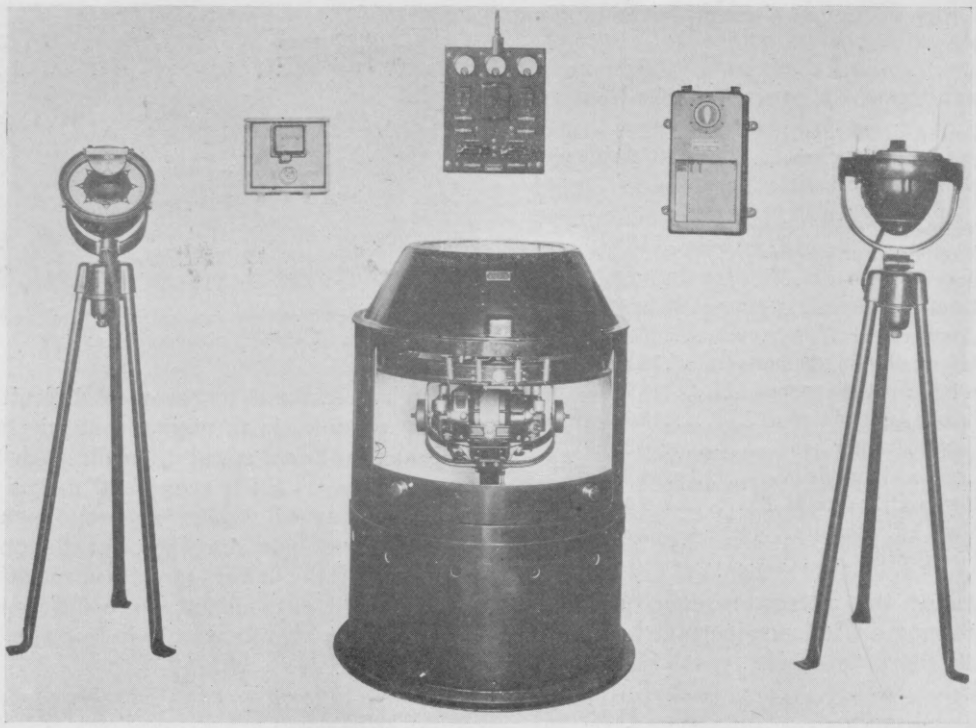

**Without helm-angle indicators it would be a difficult problem to steer a 611-ft. ship through the canals**

otherwise result from the combustion residues which normally seep past the working pistons.

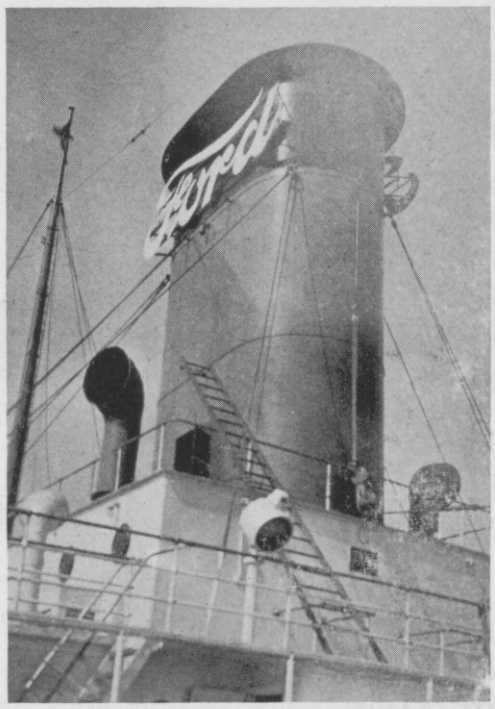
Maxim silencers are used on the Ford ships to muffle the intakes of the Worthington auxiliary starting air compressors, one of them being a 2½-inch unit for the 30-c.f.s. machine and the other a 4-inch one for the 150-cu. ft. compressor of the same make. Inside of an engine room air noises are apt to be more troublesome and actually dangerous than exhaust noises outside of it, and compressor intakes are particularly likely to endanger communication and signalling. Since the ordinary methods of muffling also have a tendency to choke off the supply, the use of devices scientifically designed to kill the noise without interfering with the suction is just one more indication that no detail has been overlooked in the layout of these engine rooms.

In the engine room there is a small Delco electric lighting set driven by a Hall-Scott gasolene engine installed for emergency purposes or for use whenever it is desired not to run the larger auxiliary oil-engines. It can be started by hand, so is not dependent upon the compressed-air supply.

Great Lakes shipping has thus been enriched by a cargo carrier of ultra-modern design and equipment, as perfect as human ingenuity and unlimited resources can make it. As the dominating feature of this unique vessel, its powerful oil engine serves as a significant index of the progress which has been made with this type of machinery and of the rapid developments which are ushering in the dawn of the Oil Engine Era.



**Gyroscopic master compass, steering repeater compass at left, bearing repeater at right with switchboard at top center and course recorder at its right and alarm unit at its left**




**The stacks bearing this name will always distinguish the two Great Lakes motorships bearing them**

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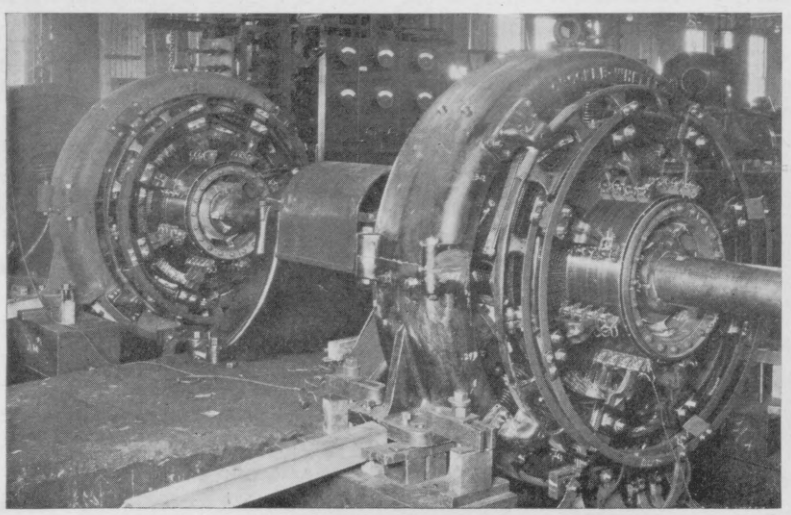
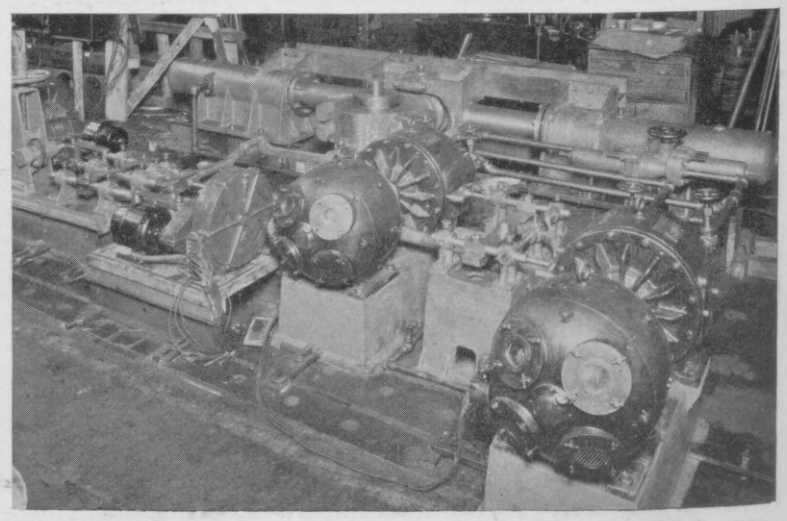
### Tanker Lio Will Have Bethlehem Diesel Engines

Contract to convert the 10,250-tons d.w. tanker Lio recently announced as having been purchased by the General Petroleum Company from the Shipping Board has been awarded to the Bethlehem Shipbuilding Corp. A six-cylinder, two-cycle Bethlehem Diesel engine of 3,000 s.h.p. at 85 r.p.m. will be installed. The present machinery on the Lio consists of a Parsons turbine of 2,650 s.h.p. and three Scotch boilers. She was built by the Baltimore Dry Dock & Shipbuilding Company in 1921 and has a bulk-oil capacity of 3,492,056 gallons and a dry cargo capacity of 35,883 cu. ft. Length, b.p. 430′; breadth, 59′; depth, 33′ 3″. Consumption, 36 tons of oil per day.



**Crocker-Wheeler generators for direct-drive by oil engines furnish current for all-electric deck and engine-room auxiliaries**



**Electro-hydraulic steering gear gives Ford ships precision in maneuvering so essential to navigation in confined waters**

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# More on the Double-Acting Diesel Engine

*Uniflow Port Scavenging System Developed by the M. A. N. Has Given Successful Test Results*

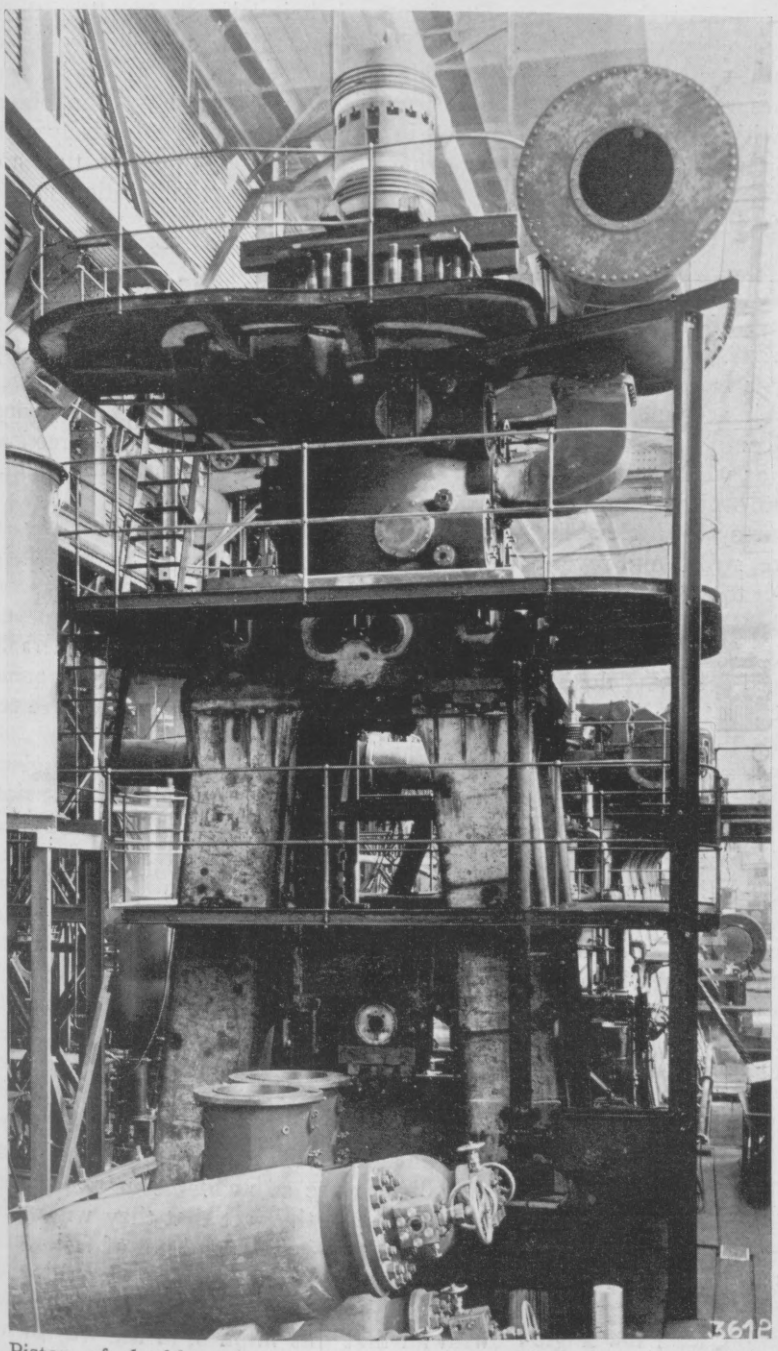
AN extended description of the M. A. N. engines which are being built under license in the United States by Hoovens, Owens & Rentschler was published in MOTORSHIP for June. In view of the fact that manufacturing rights for these engines and particularly the double-acting ones are also held by another American firm, further particulars concerning them are bound to command attention. The New London Ship and Engine Company, it will be recalled, has built Diesel engines according to their own designs and under M. A. N. license since 1910, and in the construction of the latest double-acting engine of the German firm they will have the benefit of many years of previous co-operation.

As one of the more important factors underlying the success of the double-acting engine whose development has been brought to a successful conclusion by the Maschinenfabrik Augsburg-Nürnberg may be mentioned the method of scavenging, the principle of which is self-evident from the appended diagrams. It realizes at least a part of the advantages of uniflow scavenging characteristic of opposed-piston engines without actually using two pistons. As regards the bottom cylinder end, the effect of the piston rod, instead of disturbing this scavenging cycle, is to act as a kind of dividing wall between the downward current of fresh air and the upward current of spent gases.

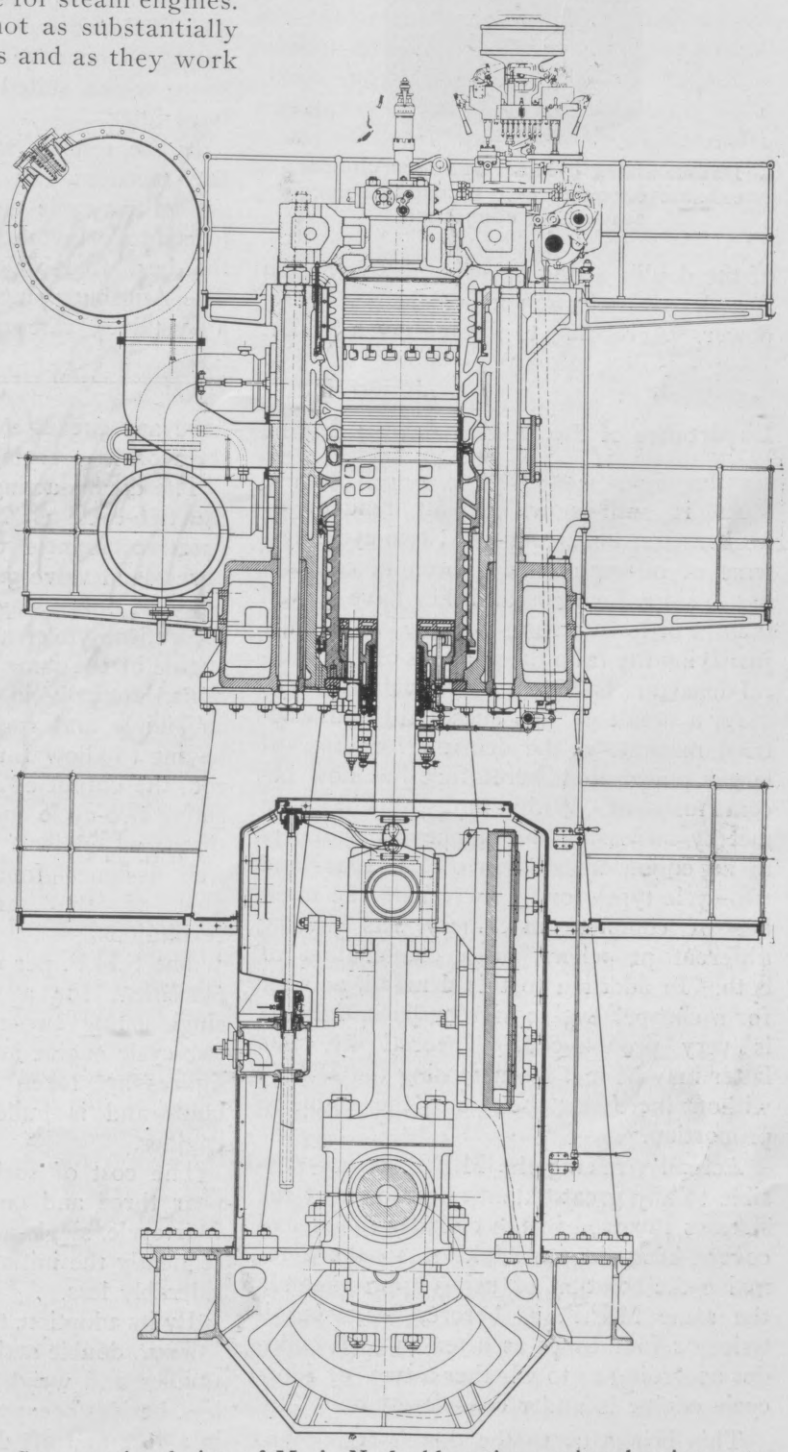
Stuffing boxes for double-acting Diesel engines are relatively less of a problem for them than they are for steam engines. Since the latter are not as substantially built as Diesel engines and as they work with greater deflections and clearances, inadequate alignment has adversely influenced steam engine stuffing boxes. The greater accuracy and rigidity of Diesel engines correspondingly minimizes stuffing-box troubles.

In contrast with the two-cycle single-acting engine the two-cycle double-acting machine possess the advantage that its working cylinder can be more effectively sealed off from the crank chamber. The long trunk necessary for sealing off the ports of the single-acting engine makes it impracticable to use a stuffing-box around the piston-rod and the less effective scraper rings must be depended upon to prevent possibility of the contamination of the lubricating oil with combustion residues.

A direct consequence of the application



Piston of double-acting two-cycle engine ready to be inserted in cylinder. It has only five rings at each end and is thoroughly water-cooled



Cross-sectional view of M. A. N. double-acting engine showing water-cooled shields in the cylinder heads. Exhaust and inlet ports are both on the same side of the cylinder

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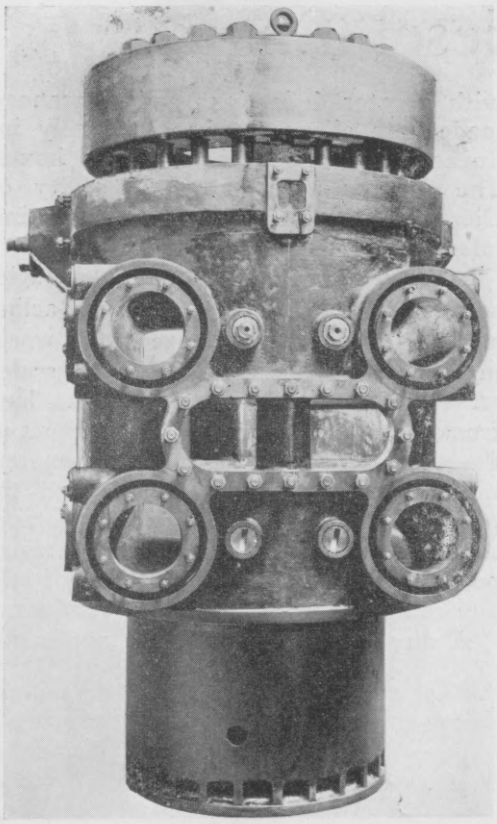
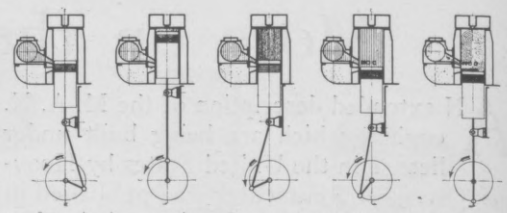


Double-acting cylinder has four circular exhaust openings and a central oblong scavenging connection

of the double-acting principle in this design is a drastic reduction in weight per horsepower. According to figures given by Dr. W. Riehm, a leading engineer of the M. A. N. Works, a 4,000-s.h.p. double-acting engine weighs 330 short tons or 165 lbs. per s.h.p. whereas a single-acting engine of the same weight would develop only 2,400 s.h.p. at 275 lbs. per s.h.p. Since, in the last analysis, cost is a question of weight, the figures given would indicate that the double-acting engine is substantially cheaper than the corresponding single-acting machine. It is not impossibie, therefore, that the use of double-acting engines will soon bring the capital cost of motorships within that of equivalent steamships, which means a lower cost per ton of net cargo capacity.

Exhaustive tests on a single-cylinder engine developing 1,100-s.h.p. at 100-r.p.m. with a bore of 31½ inches and stroke of 41⅜ inches covering many months have been concluded with a practically perfect score, as the result of which a stationary engine of this type has been ordered to develop 15,000-b.h.p. in nine cylinders. This is the corrected data on the engine referred to on page 597 of August Motorship, which stated the engine was for a large liner.

In the tests it was also shown that the fuel economy of multi-cylinder double-acting two-cycle engines may be expected to compare favorably with that obtained in the best four-cycle single-acting engines. The Augsburg single-cylinder machine has a sustained rate of fuel consumption of



Exhaust ports are located above inlet ports in new scavenging system

0.414 lbs. per s.h.p.-hr., and further reductions in this figure are expected as the result of using only one crankshaft, flywheel, compressor, etc., in common with a number of cylinders. One cylinder is apt to have a high fuel consumption.

Comparative studies made by M. A. N. engineers have convinced them that the double-acting two-cycle engine is superior to the great numbers of other types of oil-engines as a means for solving the problem of the high-power oil-engine. With this conviction in mind, they have developed the uniflow-port scavenging method herein referred to and have brought out a machine which has fully met all their expectations. The fruits of their labors as well as their continued collaboration are being made available to the engineers of their two American licensees, who have thus been placed in a position to deal effectively with powering the largest motorships that are likely to come up for consideration in the near future.

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## Importance of the Double-Acting Engine

*(Contributed)*

As is well-known to all readers of Motorship, both four- and two-cycle systems of oil-engines have been in constant use in ships for years and they have proved their worth in every possible way, fully justifying the faith the pioneers of this radical departure had in their original proposals.

As a result of this successful and well-tried machinery, the demand for units of larger power than heretofore has now become insistent. Within limits, this has been met by increasing the number of cylinders in an engine installation of the four- and two-cycle types, or by increasing the number of complete machinery sets driving different propellers, or a combination of both. In addition to this demand, another for a cheaper engine as regards initial cost is very pronounced. Theoretically, this latter may be met by increasing the M.E.P. without increasing the size of the engine in proportion.

Actually, raising the M.E.P. is not possible to any great extent on account of the stresses involved in the cylinder liners and covers becoming prohibitive, so there remains the solution of using approximately the same M.E.P. as before, but using it twice or four times as often in each cylinder according as to whether a two- or four-cycle engine is under consideration.

This brings us to the double-acting engine, and a very marked interest is being accorded this type in all countries which have any pretence at all of taking part in the world's carrying trade.

The double-acting type is best applied to the two-cycle engine on account of comparative absence of complication in the covers and valve gear, as well as the possibility of increasing the output four times theoretically over a four-cycle single-acting engine of the same bore, stroke and revolutions. Actually, in order to make the engine as simple and rugged as possible besides having to allow for the effect of the piston rod, the output of a well-designed, double-acting two-cycle engine is a trifle more than three and one-half times that of an equally well designed four-cycle single-acting engine of the same bore, stroke and revolutions.

The S.H.P. per cubic foot of piston displacement for a single-acting four-cycle, single-acting two-cycle, and double-acting two-cycle engine are as 1 : 1.8 : 3.5. These figures are taken from a firm which has built, and is building all three types of engines.

The cost of such an engine is nowhere near three and one-half times that of its four-cycle, single-acting prototype, and consequently the initial cost per S.H.P. is considerably less.

By its adoption, the following is obtained:

*First,* double-acting two-cycle engines are smaller and weigh less, and therefore cost less, besides occupying very much less space in a fore and aft direction, than the single-acting type of the same power.

*Second,* engines of the double-acting two-cycle type of the same size and weight as a four-cycle single-acting engine develop about three and one-half times the power at about double the cost, besides occupying less space in a fore and aft direction, and saving the re-location of the bulkheads.

It is therefore obvious that in order to give equal or better service on a competitive basis, that the shipowner who selects and installs a double-acting two-cycle type of engine of tried design has a considerable advantage over those who invest at the same time in a single-acting engine, of course referring to similar ships.

Already double-acting two-cycle engines are installed in ships giving good service. Already manufacturers of the United States are willing to build and guarantee such engines. Already has Congress provided means for applying the best and most efficient form of power in our merchant ships, and it therefore only remains for those gifted with foresight to take advantage of the present opportunity, never more favorable than now, and install double-acting two-cycle engines in suitable ships, from which action benefits will be obtained and advantages reaped which come from the efficient use of available motive power and also from the fact that they will be in the position of leaders and not of followers.

Such action will encourage our shipping firms and help extend our merchant marine, with all that this implies, in the way of an adequate merchant marine and a national reserve of men and ships.

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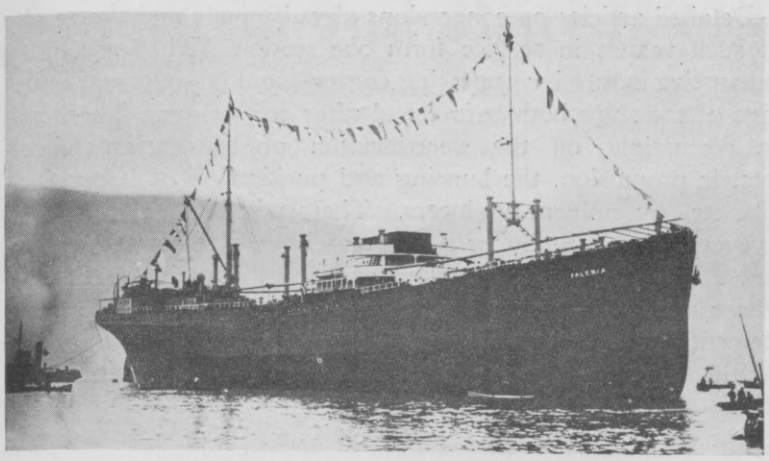
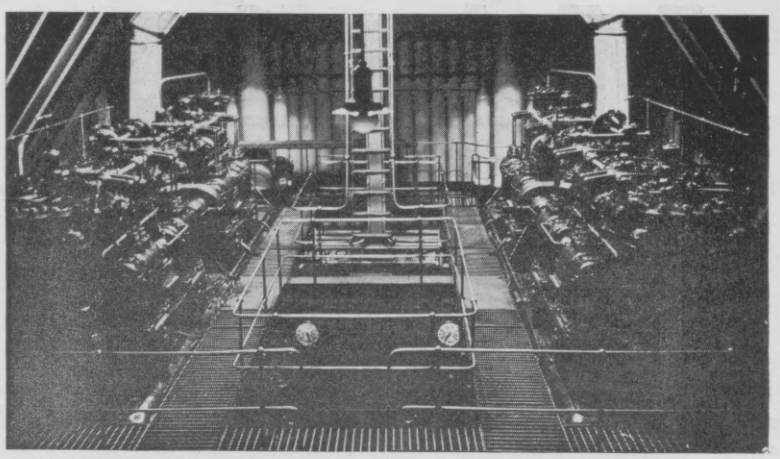


Combined cargo and passenger Motorship "Faleria"



"Faleria's" engine room, showing compact installation

# Italian Motorship "Faleria" Commissioned

*She Carries Passengers as Well as Cargo and Is Powered with Twin Two-Cycle Engines Served by Direct-Driven Auxiliaries*

COMBINED cargo and passenger motorships offer a number of attractions both to the companies who operate them and to the travelers who patronize them. Considerably lower fares than those charged on equivalent steamships also leave a greater profit margin, and the absence of coal and ashes makes a strong appeal to those who appreciate comfort and cleanliness while travelling.

Twenty-two first-class and 32 third-class passengers are provided for on the new motorship FALERIA, owned and operated by the Società ROMA di Navigazione. Tourist travel on her sister motorship, the VEJO, has proved such a success that the FALERIA was similarly equipped while under construction, although the original plans had called for cargo-handling only. Attention is incidentally called to the fact that passengers are a type of cargo which loads and unloads itself and pays a higher rate on a cubic basis than any other class.

Particulars of the hull are as follows:

| | |
|---|---|
| Length over all | 393 ft. 0 in. |
| Length bet. perps | 378 ft. 0 in. |
| Breadth moulded | 51 ft. 4 in. |
| Depth to main deck | 31 ft. 4 in. |
| Bunker capacity | 463 tons |
| Cruising radius | 12,500 miles |
| Speed, loaded | 10 knots |
| Power, two engines | 2,200 s.h.p. |

She was built by the Società Ansaldo San Giorgio, at Spezia, Italy, and is powered by twin four-cylinder two-cycle engines built by the Stabilimento Grandi Motori FIAT, of Turin. All auxiliaries essential to the operation of the main engine are direct driven; they include a twin-tandem, double-acting scavenging pump, a three-stage injection and starting air compressor, and pumps for lubricating oil and cooling water. As has been frequently pointed out in these columns, this arrangement makes a compact and convenient-to-operate power plant, and renders it possible safely to reduce the number of men in the engine-room crew. When the man at the throttle turns his engine over, he can be tolerably sure that it is getting all the things which it needs, and he is saved a good deal of running about to various parts of the engine room between bells.

Stress has been laid on securing perfect oil tightness for all the guards that enclose the engine, and, as a result, the engine room is easily kept clean and tidy. Other features of note are the center crossbands with double lateral guides mounted direct on the transverse framing. They are readily kept in line and are easily accessible from both sides of the engine. Fiat engines are among those in which the adaptation of the two-cycle principle has been a success from the start, and it is a foregone conclusion that the FALERIA will be another feather in the cap of Italian motorship achievements.

### Course on Oil Engines at Brooklyn, N. Y.

Engineers well-grounded in the operation, installation, manufacture, and design of marine and stationary oil-engines are being demanded in increasing numbers to meet the demands of an industry that is expanding with a rapidity hitherto unheard of.

The essential characteristics of internal-combustion engines using heavy oil as fuel differ so much from those of other prime movers that proficiency with the latter will not alone insure success in dealing with oil-engines. Although much information about steam and gas engines can be profitably applied to oil-engine work, specialized study and training and above all the ability to handle problems from the oil-engine point of view are essential to success with this newer type of machinery.

Systematic instruction is therefore being offered by the Polytechnic Institute of Brooklyn in the fundamentals that underlie the operation and construction of oil engines. A course entitled "Diesel and Oil Engines" will be given during the academic year 1924-1925 by J. Kuttner, Assistant Editor of MOTORSHIP, and will be repeated during 1925-1926. Several varieties of oil engines are available in the laboratory.

Special emphasis will be laid on operation and maintenance, but since it is felt that a knowledge of how and why a given type of engine came into being is indispensable for a well-grounded operating knowledge, these matters will be treated in detail. The scientific and mathematical aspects of oil-engine construction will be developed with a view to making the operator able to think for himself and will advance far enough to prepare those students who wish it for manufacturing and designing work. In any case it is planned to cover the subject in far greater detail than is necessary for passing the examinations for certificates to operate motor vessels under the Steamboat Inspection Service.

By the use of lantern slides, the mimeograph, and zinc-process reproductions from line-drawings it is planned to let the student thoroughly visualize the following:

Current types of Diesel and other heavy-oil engines.
Bedplates and framing.
Crankshafts and connecting rods.
Bearings and guides.
Pistons and cylinders.
Valves and valve gears.
Handling gear and reversing systems.
Airless and air injection.
Compressors and accessories.
Stationary governors
Installation, alignment, and fitting.
Valve setting and checking.
Starting-air, fuel, and lubricating pipes and valves.
High-pressure and ground joints.
Fuel-pump setting.
Spray-valve and atomizer adjustment.
Indicators and their manipulation.
Lubrication systems.
Governing and parallel operation.

### "Vedette" at New York

The VEDETTE, new 158-foot motor yacht just built at Copenhagen for Frederick W. Vanderbilt, of New York, at a cost of $250,000, was recently seen at the Tebo Basin, Brooklyn, where she had just arrived after crossing from Denmark in slightly more than ten days. The yacht is driven by two Burmeister & Wain Diesel engines, each of 600 horsepower.

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# Motorship

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Published Monthly in the Interests of Commercial and Naval Motor Vessels and for Recording International Progress of the Marine Heavy-oil Internal-Combustion Engine

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## Our Special Conversion Supplement

NEVER before have we compiled such a mass of information of incalculable value to American shipowners as that which will be inserted in our Ship Conversion Supplement now nearing its final stages of completion. There will be over 100 pages of editorial data and drawings. As announced on page 651 of this number of MOTORSHIP it has been necessary to postpone the Supplement until the issuance of our October number, owing to some important information now being prepared by Shipping Board officials having taken longer to compile than was anticipated. We held up publication of our September issue as long as we could in the hope that the Supplement could be produced simultaneously. However, the work on the Supplement is now so far advanced that it will only be about three weeks before copies will be in the hands of domestic subscribers. Any reader who is not a regular subscriber will do well to take the opportunity to order in advance at the price of $1.00 a copy, as we anticipate that it will very rapidly be out of print and no copies will be on the newsstands.

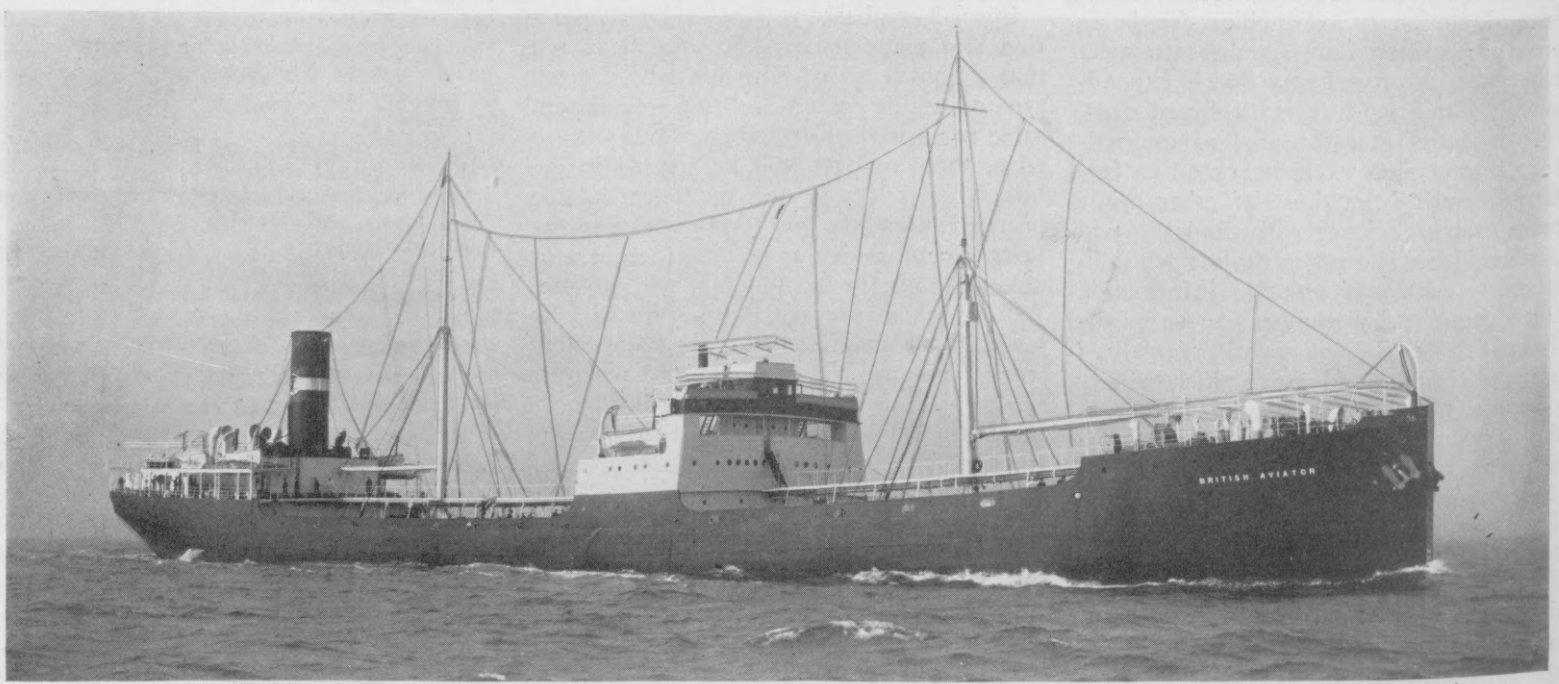
Any shipowner who is contemplating purchasing a ship from the Board and converting her to oil-engine power or who may be considering putting some form of Diesel drive in one of his own ships will find the necessary technical information in the Supplement, in addition to a copy of the contract under which the Board will sell ships at low hull value for conversion. Detailed articles on conversions already made and the results of such vessels in service form one section. They are of an exhaustive nature incorporating engine-room lay-outs and drawings of the ships both before and after conversion. There will be discussions on the electrification of auxiliaries, Diesel-electric propulsion, the burning and purification of heavy fuel-oils, etc., by eminent engineers. There will be given drawings of every class of Shipping Board vessel available for conversion, and a list and data concerning every vessel under each class. These are but some of the features that will make the Supplement indispensable to every shipowner, shipbuilder and naval architect as well as engine manufacturer for keeping fully abreast of the momentous developments set in motion by the recent enactment of the Conversion Law.

## Eliminating a Nuisance and Providing a Benefit

"CHARGED with operating their boats in such a manner that they emitted dense black smoke, three tugboat captains were arraigned in the Tombs Court."—News item.

That no Diesel-driven boats were concerned is a part of the evidence, for the simple reason that should a Diesel or an oil-engine begin to emit smoke such that it offends the not over-fastidious sensibilities of the law, it would almost be time to send out an SOS. Most oil-engines either run well or not at all and if one of them would ever start to belch forth "dense black smoke" such as that referred to, this condition would automatically bring the engine to rest long before it would catch the law's sleepy eye.

But there is another moral to the story. Except where harbor navigation is made dangerous for a few moments, smoking is perhaps the most minor of the objectionable features of steamboat operation, and the oil engine scores by comparison not only on this point but on many other points besides. The most fundamental of these is, of course, fuel economy, which in comparison with non-condensing tugs may easily attain the proportions of eight to one. Coaling and handling ashes are dirty business and although the latter can be eliminated by the substitution of oil-firing, this is so expensive an expedient that it deserves no serious consideration. As the business side of the question becomes more and more definitely settled in favor of the oil-engine drive, its cleanliness, convenience, and general desirability come into increasing prominence. The time is not far off when oil-engines will be positively demanded because of these characteristics even if they actually cost more to operate.




Motor-tanker "British Aviator" is propelled by opposed-piston diagonal-rod engine of 3,000 s.h.p. See page 666 for description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# American and British Oil-Engine Practice Compared

## *A Discussion of Current Marine Designs From the Viewpoint of a British Woman Engineer*

By Verena Holmes, B.Sc., A.M.I. Mech.E., A.M.I., Mar.E.

IN attempting to compare American and British marine oil-engines the differences are found to be neither marked nor obvious. Nevertheless there are tendencies descernible which may lead to more marked divergence in practice in the future. The first impression of a Britisher studying the American situation is that America is going ahead very rapidly in the construction of low and moderate powered engines for tugs, lighters ferries, river and coastal boats and small craft generally, but that she has only begun to realize her possibilities in the production of big marine oil-engines. No doubt this is due mainly to economic conditions. Small engines lend themselves to standardization and mass production in which American manufacturers are proverbially pre-eminent; large engines do not. The high wages paid in America make it difficult for her to compete, at present, in the production of high-powered motor vessels.

On the subject of design of large engines the two countries do not differ as much as might be expected in their views. Neither country has definitely declared for the two-cycle or the four-cycle engine. Several of the Continental European designs chosen for manufacture under licence are the same—for example, the Sulzer, Werkspoor and Burmeister and Wain engines, and mention may be made of the Doxford engine which is the first British design to be adopted in the United States. These four engines are of widely differing types, comprising as they do a single-acting two-cycle, two very different four-cycle engines and an opposed-piston two-cycle airless-injection engine. This goes to prove that both countries started out without any particular prejudice or bias.

However, it is when we come to study the designs originated in a country that we arrive at the real national preferences and tendencies, and here it is that we are confronted with certain surprises regarding developments in our respective countries.

We in England have the impression that Americans prefer machinery of a simple robust character requiring the minimum of tuning and skilled supervision; it is therefor rather surprising to find that no purely American design of large marine engine uses airless injection—other than the Falk multiple unit—more so when we consider that America has been responsible for a great deal of valuable work in the development of airless injection for small oil engines. In Great Britain, on the other hand, three out of the five principal home-designed types of big marine engines have quite satisfactorily dispensed with the air compressor.

For the same reason it is curious to find that two of the principal American builders of two-stroke engines employ valve scavenging. This in Great Britain is considered a complication, though it has the advantage that a through end-to-end scavenge of the cylinder is obtained which otherwise is only possible in an opposed-piston engine or with a sliding cylinder as in the North British engine. Valve scavenging has been avoided in England not so much on account of its complication as because there is the impression that it leads inevitably to cracked cylinder covers. Its successful use in the Bethlehem and Nordberg engines suggests that we may have condemned it too hastily.

A great deal of British enterprise and capital is going towards solving the problem of very high powers. The two opposed-piston types, the Fullagar and the Doxford, are an advance in this direction on the single-acting type and are capable of considerably higher powers than they have yet attained, but the double-acting engine, both two and four-cycle, seems to be principally engaging the attention of designers. It is no exaggeration to say that there is hardly a British firm of note that is not experimenting in this direction, with the exception of the opposed-piston engine makers, and the makers of the Still combined oil-and-steam engine, which is already double-acting in a sense.

NEVER before has an article been specially written for this magazine by a woman engineer, so the contribution on this page carries unusual interest. Miss Holmes, the author, has contributed several important papers on marine Diesel engine design, including reversing systems, before British Engineering Societies, and has displayed a clear knowledge of the subject of which many masculine designers could well be proud. She will visit the United States this Fall.

Cylinder dimensions are being steadily pushed up, and the construction of special liners for very large cylinders is receiving a good deal of attention.

These developments mark the confidence that is felt over here in the internal combustion engine, and its future application to the really big ship. It is inevitable that America also will be tackling the big ship problem, and to us it seems more than likely that they will tackle it in a different way. America has always shown a leaning towards the electric drive, and also an interest in geared transmission, whereas there is a marked reluctance in Great Britain to use anything but a direct drive. Up to a certain power the author believes that this is the right policy, but there will come a point where the difficulties of large cylinder construction and the weight increase per horse-power will fix a limit to the power per shaft that it is practicable to develop in this way.

Will America, one wonders, lead the way in the production of high powers by harnessing several engines to one shaft, either electrically or by means of gearing? There is a great deal to be said for the electric drive, and it may turn out to be the best solution for ocean liners and naval ships requiring power of more than 35,000 s.h.p. It is remarkable that in Engineer-Commander Beeman's paper, FURTHER EXPERIMENTAL WORK ON DIESEL ENGINES, read before the Institution of Naval Architects of Great Britain in April, which contains a great deal on the possible application of Diesel engine power to battleships, methods other than the direct drive are disposed of briefly as follows:

"Alternatives exist however, by means of which such a high speed engine may be used; such for example, as one of a number of power generators in an electrical transmission design, or again, as one of a number of power units geared to the propeller shaft by some form of flexible transmission. The weight of the additional fittings would certainly prohibit these alternatives, and in any case the number of power cylinders remains relatively high, so the maintenance and running liabilities of such a highly taxed design may be expected to be disproportionately high in relation to a steam plant."

Now this statement does not appear to be in accordance with facts. The employment of cylinders of very large diameter is inevitably connected with high weights per horse-power, since, with a given piston-speed the power varies with the bore$^2$, whereas the weight varies approximately with the bore$^3$. It is therefore found that for really high powers, sufficient weight is saved by keeping the cylinder dimensions moderate and multiplying the units to compensate for the weight of the electrical equipment. The question of propeller efficiency also gives the electric drive an advantage, and infinite flexibility can be obtained by this method. As regards reliability, the electrically driven ship would be in a strong position; if, say, eight engine units were used for a total of 40,000 s.h.p., the complete breakdown of one unit would not cripple the ship.

This is a digression, but the point to be made is that electric transmission for high powers has great possibilities and America is of all countries most likely to develop them, not only on account of her liking for the electric drive, but because this method would lend itself so well to the standardization of an engine unit which could be applied to a wide range of total powers.

For moderate powers, American builders appear to have developed a number of thoroughly satisfactory Diesels, mostly on the four-stroke cycle, and these do not differ in essentials from the British engines of the same power. During the war the writer

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was working in a central England engineering shop on parts of a small submarine Diesel engine of American design. The very first of these engines when started up on the test bed ran without a fault and was ready to go out within a few hours of being finished. This shows that American designers have not much to learn about this class of engine—the moderate powered four-cycle.

In small engines, as already stated, America seems to be going ahead and to be finding the four-cycle airless-injection the most suitable unit, on account of its simplicity and low first cost. This differs with current British practice where engines of the two-cycle surface-ignition type are making considerable headway in fishing vessels and small yachts where skilled supervision is not available. Yet, the output of a certain American firm of surface-ignition engine builders would make most European manufacturers envious! Even this firm, the writer understands, are now turning to the airless-injection, higher-compression system.

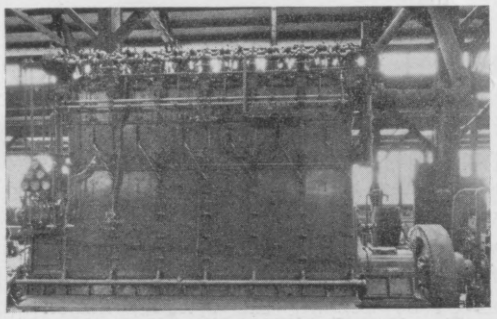
Seriously speaking, though there is no room for jealously, international or other, at this stage in all engine and motorship development. Every reliable motorship that puts to sea is an advertisement for this type of vessel, which reacts to the good of all oil-engine builders, and we in Great Britain are glad to see the extent to which America is alive to the importance of having an oil-engined merchant fleet.

The British have the reputation of being a conservative nation—we spend some time dipping our toes in the water before we plunge. As regards motorship building we may now be said to have plunged, since we are responsible for nearly 50% of the total motorship tonnage under construction—some of which is for American ownership—and original types of engine of our own design are meeting with marked success. We may expect the American industry to develop along the same lines. The passing of the Conversion Bill should give America an excellent opportunity of organizing for engine production and put her in a position to compete with European manufacturers. Perhaps something analogous to her history of automobile engineering may take place in motorship building. We in Great Britain will watch with interest.

# Tanker "Pinthis" Converted to Modern Diesel Power

*This Single-Screw 1,750-Tons Vessel Now Has a 525-s.h.p. at 190-r.p.m. Diesel Engine with Crossheads, a Construction Which Increases Accessibility and Reduces Upkeep*

THE motor-tanker PINTHIS has just completed the installation of new Diesel engines at the yard of the Newport News Shipbuilding & Drydock Company and has resumed her service out of Fall River, Massachusetts. This vessel owned by the New England Oil Refining Company of Fall River, Massachusetts, and operated by C. D. Mallory & Company, Inc., 11 Broadway, New York, has been equipped with her new engines in record time, having actually been delivered to her owners in exactly twenty-five (25) running days from the time of her arrival at the yard.



**Appearance of "Pinthis'" engine with crank-case doors in place**

This sturdy bulk-oil carrier, built at Newburgh, New York, in 1919, is well suited to fully realize the advantages which can be obtained by the use of modern oil-engine drive. Her particulars are as follows:

| | |
|---|---|
| Length, over all | 216 ft. 7 in. |
| Length, bet. P.P. | 208 ft. 0 in. |
| Breadth, moulded | 35 ft. 6 in. |
| Designed deadweight | 1,750 tons |
| Loaded draft, mean | 15 ft. 3 in. |
| Main engine power | 525 B.H.P. |
| Bunker-oil capacity | 54 tons |

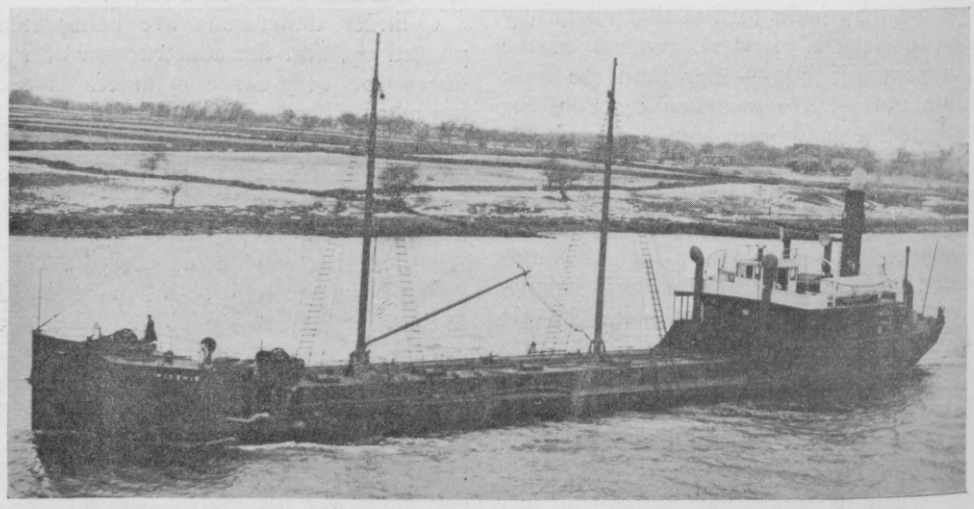
As it is necessary for an efficient heating system for all-year-round operation along the New England coast, this vessel is equipped with donkey-boiler and steam auxiliaries.

The main and auxiliary engines built by the Pacific Diesel Engine Company of Oakland, California, are their first installation of this power on the Atlantic Coast, although they have many installations in successful service on the Pacific Coast. O. S. Johannsen, eastern representative of this company, was instrumental in securing the adoption by C. D. Mallory & Company of the engine which is described in this article.

Particular attention is merited by the new main engine—a 525-b.h.p. four-cycle six-cylinder unit manufactured by the Pacific Diesel Engine Company under license from Werkspoor, of Holland, with modifications to suit American requirements. The rated power is developed at 190 r.p.m. in cylinders having dimensions of 16½ by 23⅝ inches. Although the general characteristics of this design have been given considerable publicity, the new engine on the PINTHIS will attract attention for several reasons.

Although the engine is of small size, it has the same constructional features as the machines which are intended for ocean-going vessels of considerably larger power. It is particularly interesting to note how the framing is put together as shown on the accompanying illustration reproduced from a photograph taken in the course of installation. Forged steel rods—one of the features of this make of engine—tie the entire structure together with a high degree of reliability. Forgings such as those from which the rods are made can be readily controlled as to strength both in design and manufacture and are superior to cast-iron for the transmission of tension stresses. They show up plainly in the illustration and give the impression of imparting great strength. As a matter of fact they are many times as strong as they would have to be in order to resist the determinable loads that arise within the engine, but their greatest importance lies in their completely doing away with deflections and "working."

Crossheads, too, are used on this engine and whereas engineering opinions differ as to the necessity of using crossheads for an engine of 525 b.h.p., there can be no doubt that they have decided advantages in their favor even for this power. They afford operating conveniencies and economies which cannot be readily attained without them and which may warrant the relatively



**Motorship "Pinthis" has just had Diesel engines of a modern type installed**

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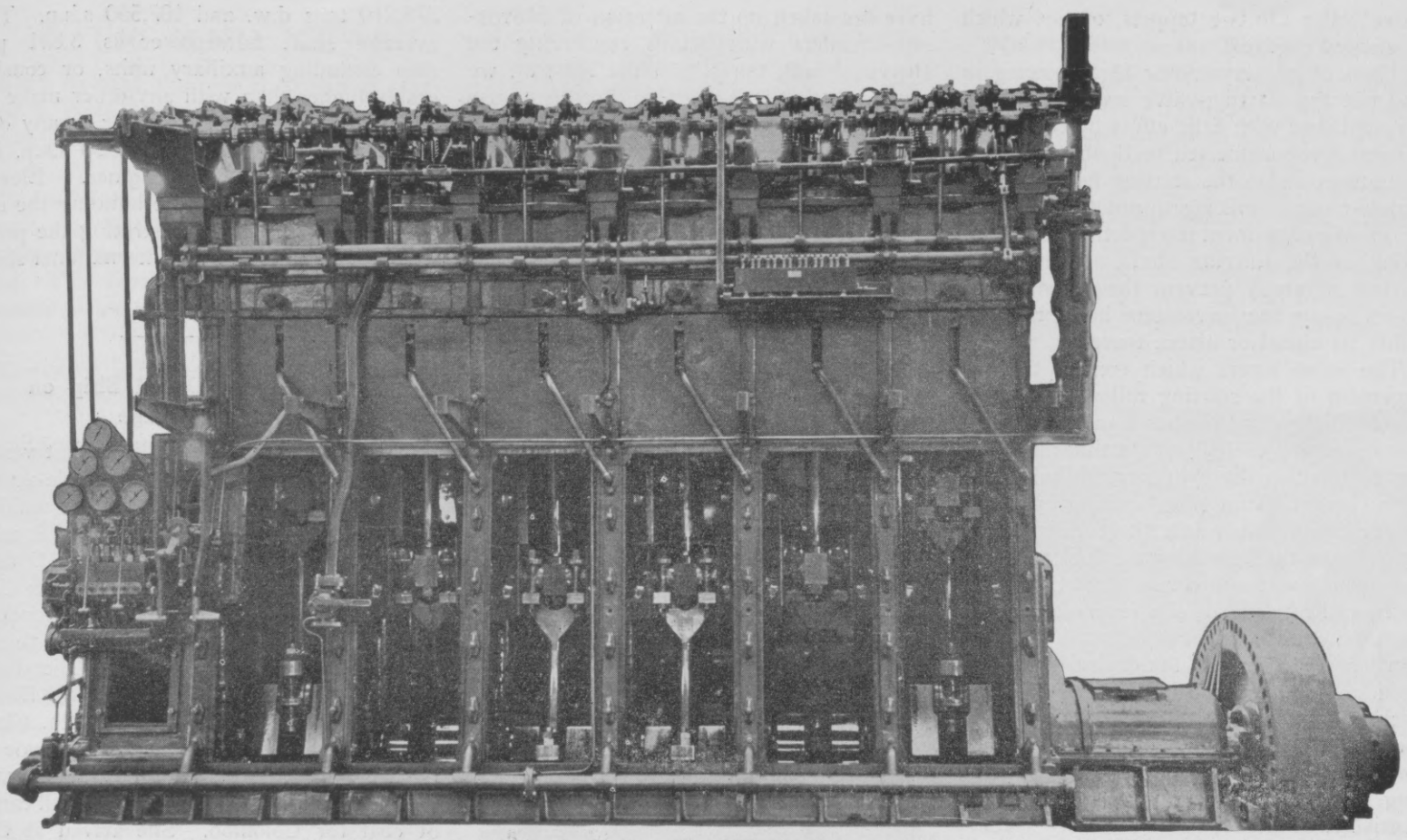


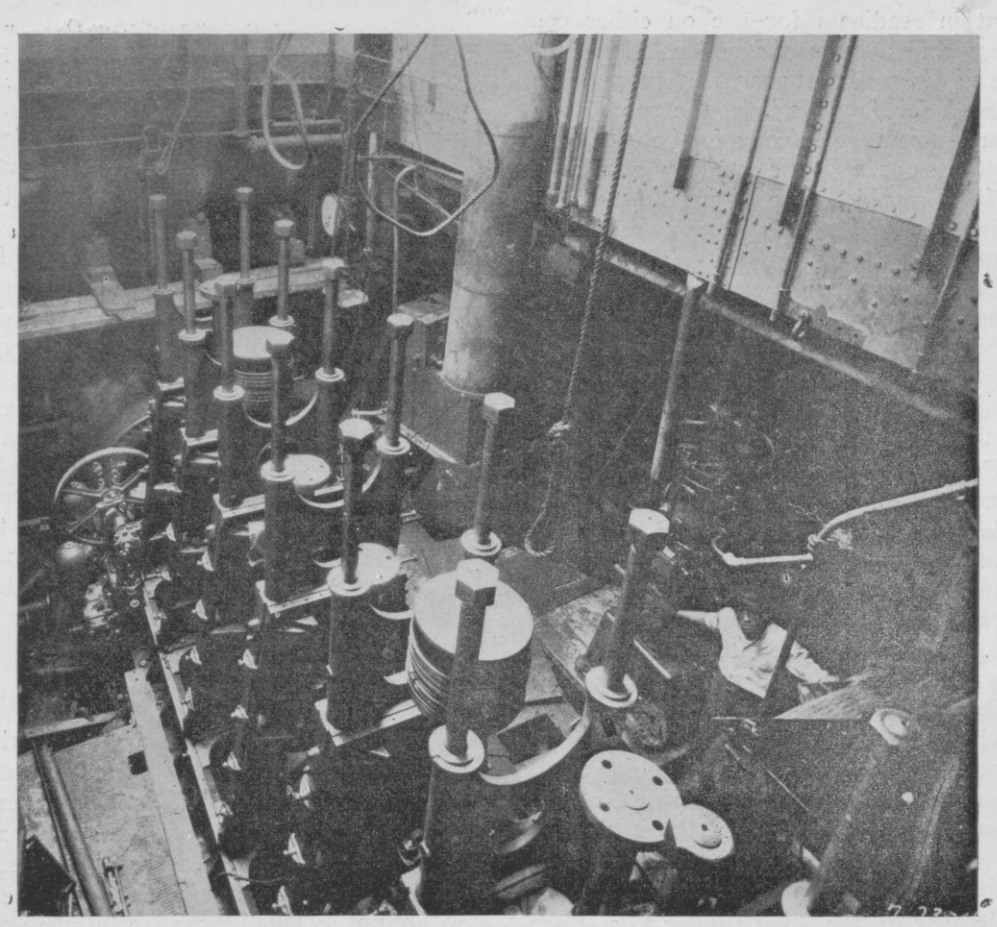
**Crossheads are a feature of this 525-s.h.p. engine, in the design of which sturdiness combined with accessibility have been governing considerations. Splash doors are shown removed for photographic purposes**

slight additional weight and expense due to their use.

Information concerning Diesel engines is now so widely current that attention needs hardly to be drawn to the fact that it is a good thing to have the wrist-pin ends of the connecting-rods out in the open where they can be readily observed and adjusted. Trunk-pistons engines with the wristpins located far up inside of the pistons are regularly giving good service in engines of this size, but if other considerations are disregarded for the moment there can be little argument as whether a wrist-pin out in the open is preferable to one located inside of a long trunk. The wrist-pin of a crosshead can be made of ample size, is effectively cooled by the motion of the fresh air around it, and possesses a high degree of accessibility. The latter quality is a relative one, since it depends on the importance of the part considered. No one would ever think of calling a rib on the underside of a bedplate inaccessible, whereas a fuel pump housed inside of a box-frame might be considered decidedly so. As one of the major moving parts of an engine, the wrist-pin in an engineering sense would appear to be entitled to all the accessibility that can be secured for it.

Among the other well-known features of this engine are the method of reversal, which is accomplished without sidewise shifting of the camshaft. Since the valve rockers are mounted on a common fulcrum shaft by means of inclined-plane eccentrics, it is merely necessary to give the latter a one-half turn in order to lift the rollers clear of the cam-noses and to bring them down again on the astern cams. Rotation of the fulcrum shaft it carried out by means of a servomotor supplied with starting air and controlled with piping and a valve from the maneuvering stand.

Only the exhaust, starting, and inlet valves are reversed by this method, whereas the fuel valve is separately treated. Its rocker lever is mounted on an eccentric of normal design mounted on the fulcrum shaft and is displaced in its own plane by an amount which is sufficient to make the small angular correction necessary for changing from ahead to astern running. On the end of the lever nearest the fuel



**The "Pinthis" engine in the course of installation. Framing and crossheads have been mounted and two of the pistons flanged to the connecting rods**

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valve collar are two tappets, one of which is always engaged.

There is no servomotor for throwing in and out the starting-valve levers. This is accomplished with little effort by the use of a hand lever connected to double-eccentric mountings inside the starting lever hubs, a simple motion sufficing to put the levers in or out of engagement irrespective of the position of the fulcrum shaft. Interlocking devices naturally prevent the use of these levers before the servomotor has completed either its ahead or astern travel.

The same levers which control the engagement of the starting rollers also operate the fuel pumps in such a way that there is no pumping as long as starting air is being supplied to the cylinders. Moving the hand levers from the starting position through neutral towards the running position allows the supplying of fuel to begin and turns on the injection air. Over this part of the travel of the levers saw-teeth and a pawl allow them to be set in all positions corresponding to the engine speed desired. There are two of these levers, one of them for the forward and the other three for the after three cylinders and it is therefore possible to keep one set of three running on air until the others are firing positively.

Starting air is normally supplied by the main engine compressor, but for emergency purposes and heavy maneuvering demands a steam-driven standby is available. The latter is an exact duplicate of the one on the main engine, a fact of no small consequence when the enormous conveniences and savings due to the interchangeability of the parts is considered. Spare valves, for instance, may be cleaned and ground and be kept in readiness for use on either compressor at a moment's notice. Since they are so designed that spares are normally not needed for long periods, the same set of spares answers perfectly for both of them. Last but not least, the auxiliary compressor is fully capable of supplying the main engine, so that the latter's own compressor may be entirely relieved of work if need be. As the result of the power thus saved it is conceivable that the net power on the propeller shaft might be considerably increased, a procedure would be equivalent to adding a part of the ship's auxiliary power to the main propelling machinery.

Exhaust gases are expelled through a Maxim silencer, a device which scientifically kills noise with the imposition of a minimum of back-pressure on the discharge of spent gases from the engine. Whereas the usual type of muffler merely chokes off both the gases and the noise, the silencer on the PINTHIS merely destroys the sound waves without appreciably interfering with the discharge of the gases. Since the ultimate measure of the power of an engine is the amount of air and gases which can be passed through it per hour, the importance of selecting silencing equipment of proper design can hardly be overemphasized.

Because of her being similar to a steamship except for her main propelling unit, we have not taken up the attention of MOTORSHIP readers with details concerning the PINTHIS' hull, tanks, and the like; all we can say is that if it pays handsomely to use a Diesel engine for the main propelling power in spite of being handicapped with continuously-operated steam auxiliaries, the advantages in most cases of 100 per cent motorization need hardly be to be elaborated upon.

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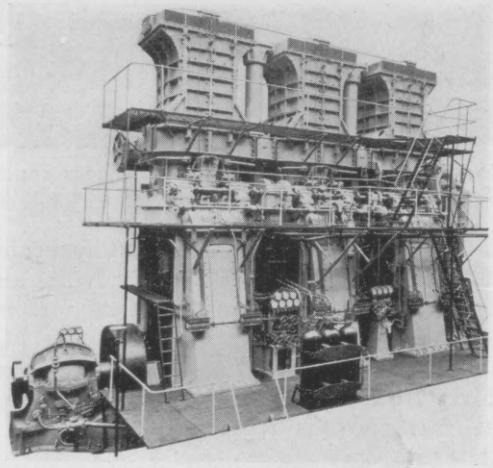
### Ship Trials of Largest Fullagar Type Diesel

BRITISH AVIATOR, the first motor-tanker ordered by British Tankers, Ltd., and equipped with the largest Fullagar-type opposed-piston Diesel yet in service ran successful sea trials on the 7th and 8th of August. This single-screw vessel, built and engined by the Palmers Shipbuilding & Iron Co., Jarrow-on-Tyne, England, who also are building a *steam-tanker* for the Gulf Refining Co. of Pittsburg, Pa., has a



**Power plant of the "British Aviator," the largest single-screw installation of this type which has been made so far**

deadweight of 10,000 tons. She is propelled by a six-cylinder 23″ by 36″ Palmer-Fullagar oil-engine of 3,000 s.h.p. and is 440 ft. long by 57 ft. breadth and 33 ft. 11 in. depth. With the engine developing 2,887 s.h.p. on the first day the ship attained a speed of 11.63 knots. On the second day the vessel was run at the normal service speed. There was a complete absence of vibration. With the exception of the two Ford motorships, the BRITISH AVIATOR is the highest-powered single-screw motorship yet in service. At the luncheon on board, A. B. Gowan, managing director of the builders, presided. We presume that this fine vessel will shortly visit the United States.

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### Twenty-eight Large Sulzer Diesel Ships

The extent to which Sulzer single-acting Diesel marine engines have been adopted is not widely known. From Sulzer-Freres we have just received a list of merchant motorships engines by them and their licensees. Although vessels under 5,000 tons d.w. are not included there are twenty-eight vessels built or building aggregating 273,210 tons d.w. and 107,550 s.h.p. The average shaft horsepower is 3,841 per ship excluding auxiliary units, or considerably higher than with any other make of oil-engine. The highest power in any one vessel is 13,000 s.h.p., or 14,600 s.h.p. including the auxiliary engines. Eleven different firms built or are building the engines for these ships, illustrating the prestige of this design in the international shipbuilding industry.

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### Double-Acting Diesel Ship on Maiden Voyage

The motorship SWANLEY, the first vessel to be fitted with British-made double-acting engines, uneventfully completed her maiden voyage from Cardiff to Colombo. It may be recalled that this vessel of 9,300 tons d.w.c. was built by Barclay, Curle & Co., Glasgow, for Harris & Dixon of London, and is engined with a single-screw, three-cylinder, two-cycle, double-acting Diesel engine made by the North British Diesel Engine Works, Limited, Whiteinch, Glasgow. Following her trials on the Clyde at the beginning of last month the SWANLEY proceeded to Cardiff and loaded a full cargo of coal for Colombo. She arived at Colombo on 5th of August, having made a non-stop passage with the exception of the Port Said call on passage through the Canal.

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### Demonstration of "P. R. R. No. 16"

Demonstration runs of the new Diesel-electric tug P. R. R. No. 16 made on the Hudson River on August 20 gave convincing proof to large parties of guests that this new craft represents one of the most significant advances recently made in the art of tow-boat construction. As was stated in our article in MOTORSHIP for August, the P. R. R. No. 16 is powered with twin Winton engines direct-connected to Westinghouse generators and exciters which furnish current to a double-armature propelling motor flanged to the propeller shaft. By the use of the Ward-Leonard control for the small excitation current of the generator armatures an unbelievable degree of flexibility and sensitiveness in the maneuvering of the tug was attained. Invitations had been extended by F. L. Dubosque, superintendent floating equipment of the Pennsylvania Railroad, to those prominently associated with oil-engine manufacture and motorshipping, including ourselves. There was a good representation of naval architects and of men well known in the tow-boat industry.

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The Diesel-electric fruit carrier, LA MAREA, when endeavoring to avoid two schooners recently, ran ashore at Port London, and was obliged to jettison her cargo of bananas before she could be floated. Don't tell us, please, what song the crew sang when the bananas were all overboard.

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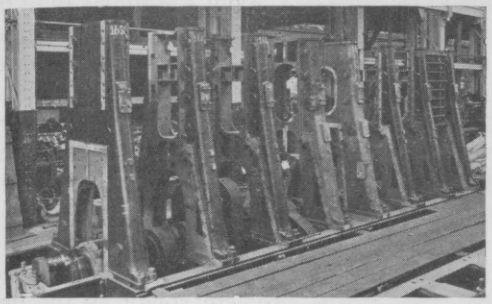
# NOTES AND NEWS

Lord Kylsant, the new chairman of Harland & Wolff, is perhaps better known to the shipping men as Sir Owen Phillips.

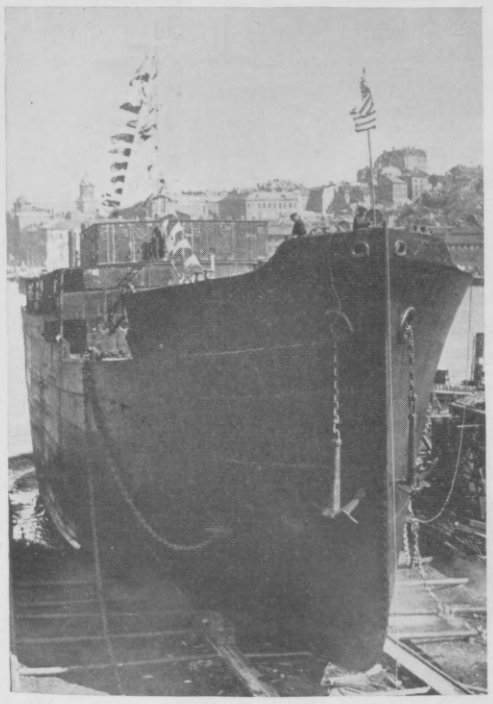
Walter Runciman & Co.'s first motorship VINEMOOR, 8,100 tons d.w., was launched on July 30th, at Doxford's yard, Sunderland. This vessel is fitted with a Doxford opposed-piston oil engine of 2,200 s.h.p.

LUBRAFOL is the name of the 10,100 tons Armstrong-Sulzer Diesel-engined tanker



**Latest Werkspoor Diesel-engine frame-construction**

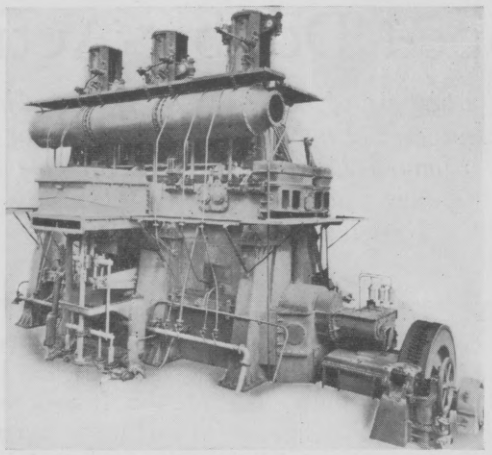
launched during July at Newcastle-on-Tyne. The power plant consists of two four-cylinder, two-cycle engines, aggregating 2,700 s.h.p., which will give the vessel 11 knots speed with a d.w. of 10,100 tons on 26' 4½" draft. The length of the vessel is 440 feet by 57.2 feet breadth and 33.1 feet depth.



**The "City of Panama" taking the water at the Götaverken, Göteberg, Sweden. Note the American flag**

Frank H. Madden has been appointed receiver of the Allan-Cunningham Co., Inc., Seattle, by the Superior Court of the State of Washington, and will proceed to liquidate the assets of this concern for the benefit of all creditors, as speedily as possible.

Werkspoor, of Amsterdam, made a profit for the past year of 1,201,508 guilders.

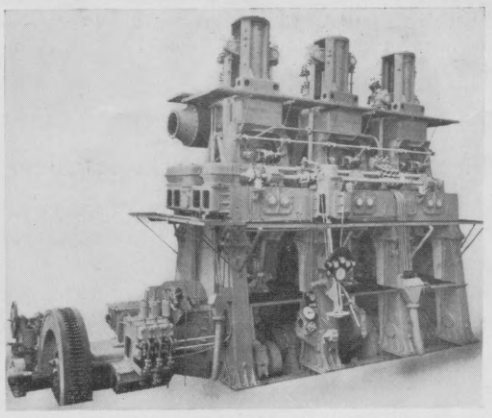


**An unobstructed view of the Doxford engine on the Roosevelt motorship "Silverfir"**

After deducting expenses, employees' fund, depreciation, etc., the available balance is 564,302 guilders. The dividend of 5½% on A shares and 4¾% on B shares was paid. Their new design of frame construction is shown on this page.

**American-owned Motorship "Silverfir" under full headway from Newport to Bahia Blanca**

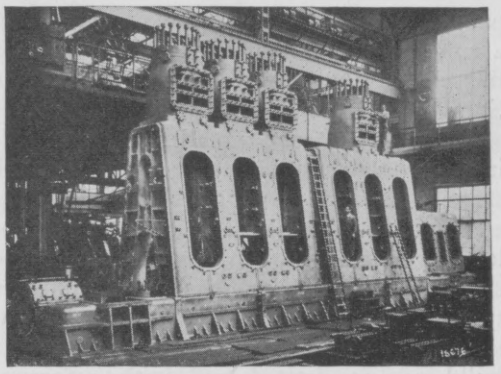
The 6,500 tons d.w. tanker referred to previously as building for the De Maas Steam Navigation Co., at Rotterdam, is to have Harland-B. & W. Diesel engines, and a sister ship for the same concern is to have Fijenoord-M. A. N. engines, building at the Fijenoord Shipyard.



**Control side of "Silverfir's" opposed-piston engine**

### Nelseco Engine for Harbor Tugboat

To the order of the Stanwood Towing Company of New York City, a four-cylinder Nelseco Diesel engine of 120 s.h.p. is being installed in their wooden tug, ROYAL, at Jacobson & Peterson's Yard, Sheepshead Bay. A reversing clutch is used. Dimensions of the boat are 50 ft. x 14 ft. 2 in. x 6 ft. 5 in. and it will be used for general harbor work as well as for towing sand and gravel barges between Jamaica Bay and New York Harbor.



**The big single-screw Sulzer Diesel engine for the Motorship "Bintang"**

### New Diesel Development Company

For the purpose of ensuring sustained progress of the heavy-oil engine, especially in the direction of greater power cylinder with correspondingly reduced weight and initial cost, a new company known as the Internal-Combustion Development Co. has been formed by Franco Tosi of Legnano; Wm. Beardmore & Co., Dalmuir; Furness Withy, London and New York; and Richardsons Westgarth, Hartlepool, with Sir George Goodwin as chairman.

**Oil-engined work-boat serves Merritt-Chapman-Scott dredges operating in New York harbor**

The various concerns forming the company will collectively design one or more types of marine oil-engines based on the combined experiences of the companies. The two-cycle double-acting Diesel will be featured. This co-operation between the shipowner, the shipbuilder and the marine engineer should be very helpful in a broad sense to the industries involved and a similar policy could be followed here. It is an endeavor to effect a more rapid solution of the vital problem of the first cost of what promises to be the dominating means of economical ship propulsion in the future.

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# American-Developed Double-Acting Diesel Engine

*Particulars of a New Two-Cycle, Air-Injection Engine Capable of Being Flanged Directly to Existing Propeller Shafts in Shipping Board Vessels With Minimum Hull Alterations*

DOUBLE-ACTING engines, in view of the Shipping Board's present demand for single units of large power, are being more and more actively considered by most of those connected with the big Diesel engine industry. One of the most recent additions to the list of such engines available for ship conversion work is the double-acting, single-cylinder, two-cycle engine whose development has been concluded by the Worthington Pump & Machinery Company. We had the pleasure of witnessing a run of the first single-acting cylinder of this engine about a week ago at the firm's Snow-Holly plant in Buffalo, N. Y.

Nowadays no one would think of building a single-acting steam engine, and the same logic points to the double-acting Diesel engine as an imminent solution of the problem of putting enough power on a single shaft to meet the demands of the commoner type of cargo carrier. This applies particularly to those ships on which space between bulkheads is limited and with reference to which a decision to use the direct drive with maximum power has been reached.

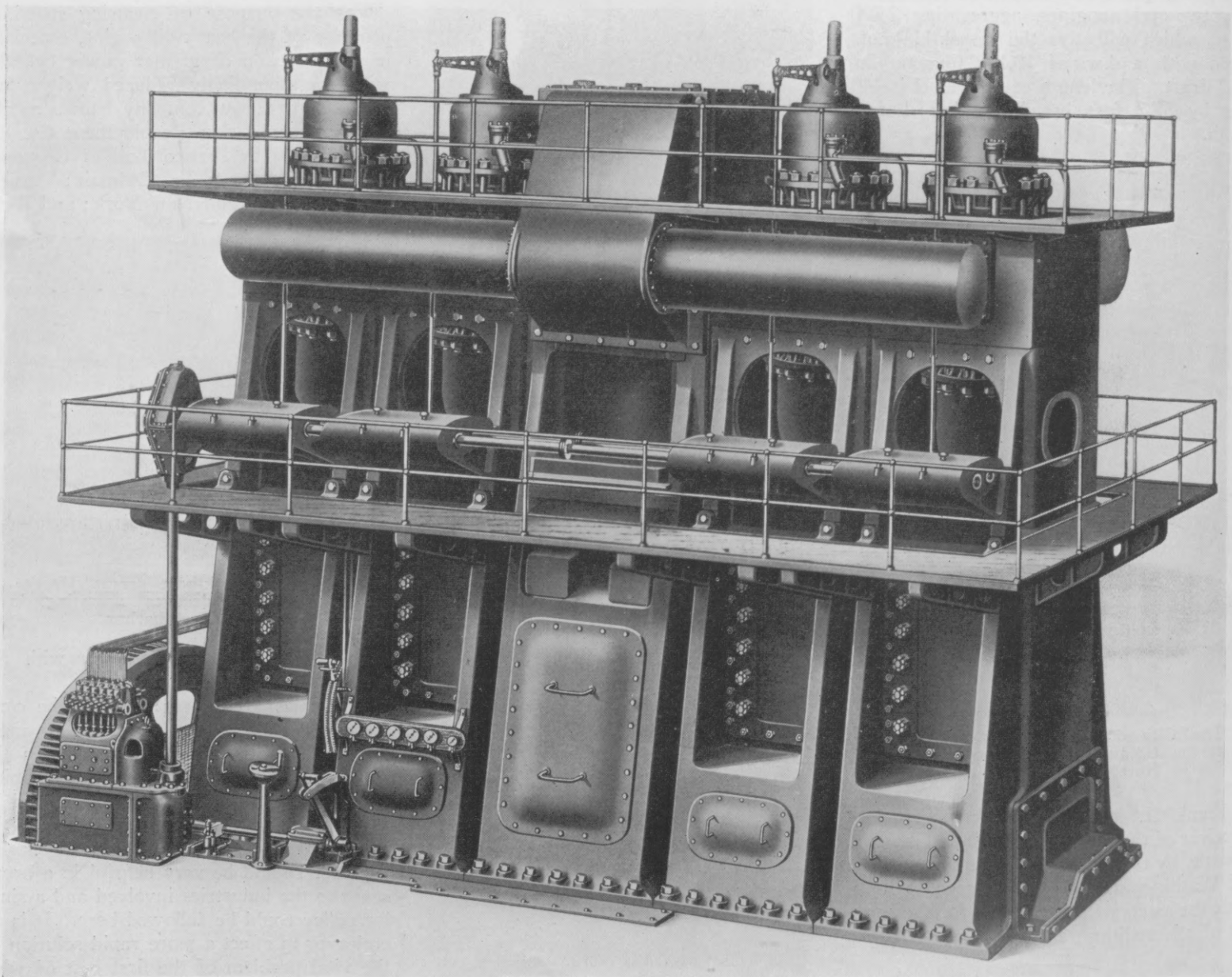
Whereas a large share of the progress which has been made with Diesel engines is due to the initial use of the four-cycle, single-acting design, most engineers agree that there is a fairly definite limit on the power per cylinder capable of being developed by such machines. The most rigid of these limitations appears to be imposed by the rate of heat-transmission through the cast-iron of the cylinder walls.

As cylinders increase in size, their cubic contents increase as the third power of the bore, while the total surface available for the transmission of heat depends roughly on the square of the bore. At the same time the thickness of the walls through which the heat must pass is in direct ratio to the bore. It may herefore be said in a general way that the rate of heat transmission, expressed as the number of B.T.U. going through a square inch of wall per minute per degree or internal and external temperature difference per inch of thickness increases as the square of the bore. For a 30-inch cylinder the degree of intensity of heat transmission is four times as great as for a 15-inch cylinder and nine times as great as for a 10-inch cylinder.

Little wonder, therefore, that many designers consider somewhere around 30 inches to represent about the upper limit of what cast-iron under present metallurgical limitations will stand in the way of heat transmission from Diesel engine cylinders. Little wonder, also, that six-cylinder, four-cycle, single-acting engines having a capacity greater than 2,000 s.h.p. have been constructed in limited numbers.

In the light of experience gained thus far it would appear that the attempts to solve the large-engine problem solely by the use of increased cylinder sizes have been temporarily blocked, at least. Following are

(*Continued on page 673*)



**Simplicity is the outstanding feature of this Worthington double-acting two-cycle engine, which develops 2,400 s.h.p. in four cylinders. The only valves having a mechanical drive are those for fuel injection, the starting valves being relay-operated**

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(*Continued from page 668*)

the four systems according to which the cylinder sizes which have been found practicable to date can be used: 1. Four-cycle, single-acting. 2. Two-cycle, single-acting. 3. Four-cycle, double-acting. 4. Two-cycle, double-acting. For a given bore, stroke and piston speed, No. 1 represents the minimum power and No. 4 the maximum; just how they compare in actual numerical value is estimated by the Worthington engineers as follows:

Assigning the figure 100 to the four-cycle, single-acting the two-cycle s.a. would develop 200 if it had the same brake m.e.p. Worthington states that it has only 78 per cent as much and assigns 156 as the ratio number applicable to the two-cycle s.a.

Double-acting cylinders both of the two and the four-cycle types do not develop the same brake mean effective on the lower end as they do on the upper, not only because of the piston area canceled by the area of the piston-rod, but also because the presence of the rod, with few exceptions, interferes slightly with the carrying-out of both cycles. The lower end is therefore taken to be 90 per cent as effective as the upper end.

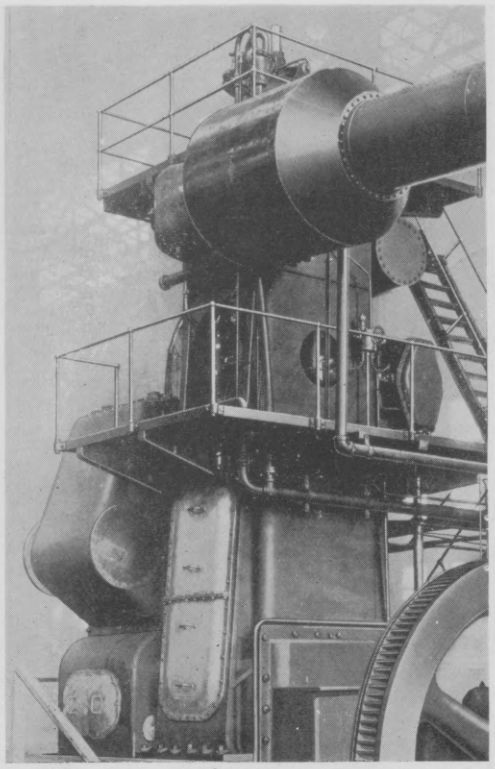
Accordingly the figure for the four-cycle, double-acting engine is 190.

On the basis of 156 for the single-acting two-cycle the double-acting of this type would be increased to $156 \times 0.9 + 156 = 296$. The foregoing figures, which may be regarded as being very conservative, are summarized by the Worthington engineers in the following table:

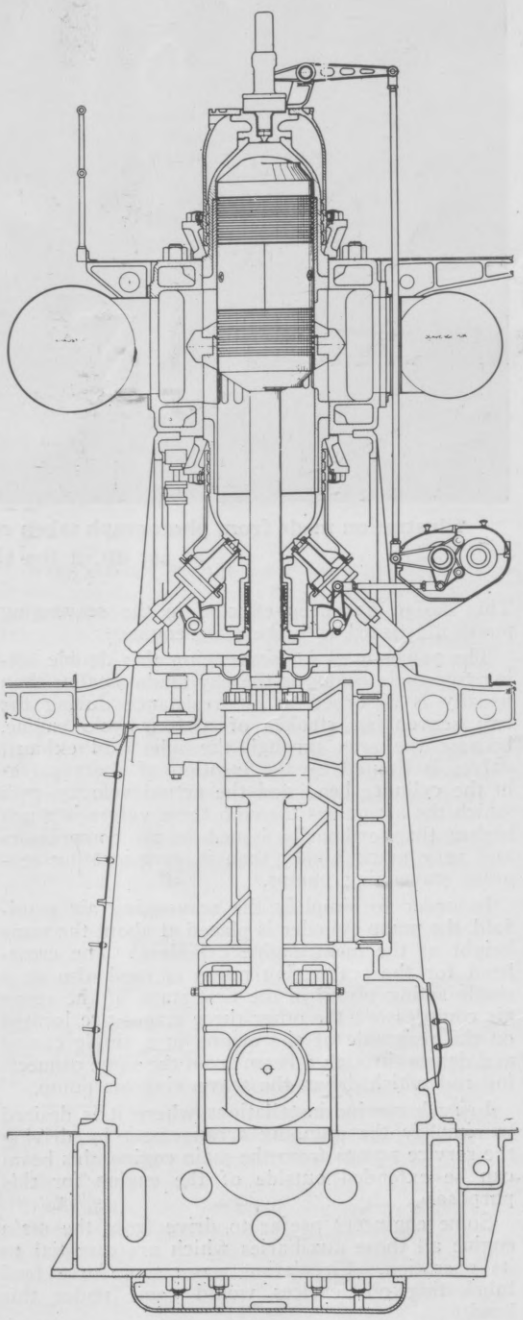
| | |
|---|---|
| Single-acting four-cycle | 100 |
| single-acting two-cycle | 156 |
| Double-acting four-cycle | 190 |
| Double-acting two-cycle | 296 |

There can be little doubt that the use of the double-acting principle, besides offering the increase in power which is urgently demanded, also possesses a number of attractive features in addition. Because of the greater number of power impulses acting on the crankshaft, smaller flywheels can be used and propeller shafting of smaller diameter is accepted by the insurance companies. Bearing pressures are relieved to a remarkable extent by the opposing gas pressures with the result that the double-acting, two-cycle engine compares favorably even with the four-cycle, single-acting engine in this particular. To the best of our knowledge the main bearings of the two-cycle d.a. M.S. Fritz resembled those used on tramp steamers; the lubricating system for them consisting of a rectangular hole in the bearing cap with a sheet-brass box around it. All the figures which could possibly be compiled on the subject of bearing forces and the like do not carry as much conviction as this simple fact.

In what follows is given a description from the pens of the Worthington engineers of their double-acting, two-cycle engine. Six hundred horsepower per cylinder are developed by the design under consideration. Whereas the bore of the cylinder is 27 inches, the piston stroke is 40 inches and the speed is 90 r.p.m. It would appear that under these conditions a brake mean-effective pressure of about 61 pounds is attained, 316 b.h.p. being developed in the top end and 284 in the bottom end. This rating apparently gives the engine a liberal factor of safety.



**Rear view of the Worthington double-acting engine**



**Double-acting engine has steel combustion-domes top and bottom**

As now built at the Worthington Pump and Machinery Corporation, Snow-Holly Works, Buffalo, New York, the double-acting engine consists of a single unit of a four-cylinder engine. It is the intention to build engines of three, four, five or six such units placed on a common bedplate and working on a common shaft.

The frame and running gear on this engine follow conventional lines. The former is cast in box section; it is entirely enclosed with oil tight doors suitable for lubrication of all parts under pressure, but separated completely from the cylinder so that no exhaust gas can penetrate the crank case, even should the piston rod stuffing box leak. A scraper ring arrangement on the piston rod prevents lubricating oil from travelling from the crank case into the cylinder.

On the frame is placed an extension to support the cylinder base, which is bolted directly to the bedplate by means of four tie bolts, relieving the frame of all tensional stresses. The cylinder base, shown in the section, is an iron casting which serves several purposes:

(1) As a part of the frame, it serves to transmit the force from the combustion pressures from the top or the bottom cylinder to the main framing.

(2) Connected on one side to the scavenging air manifold and on the other side to the exhaust manifold, it serves to introduce scavenging air and lead away the exhaust gas from the top and bottom cylinders.

(3) Arranged for water cooling, it serves to introduce cooling water into the jacketed spaces around the top and the bottom cylinders so that the water passing through holes drilled in the bridges between the scavenging air ports and the exhaust ports cools the center part of the cylinder effectively with water at the lowest temperature.

The top and bottom cylinders are alike; each consists of a steel shell of a shape suitable to resist the gas pressures. They are made with a substantial shoulder on the outer circumferance suitable for securing the shell to the cylinder base by means of a clamping ring which, in turn, is bolted to the cylinder base by heavy studs, similar to the cylinder head studs in the engines by conventional design. Into this steel shell is pressed a cast iron liner, which contains, at the open end, the ports for the introduction of scavenging air and ports for the outlet of exhaust gas. The free end of this liner rests on a heavy flange projecting inside the center bore of the cylinder base, in which bore the upper and lower cylinders are guided, thus securing perfect alignment. Around each cylinder is placed a light jacket of cast iron bolted to the top end of the cylinder and guided in the clamping ring against which it is tightened by means of a stuffing box with gland.

With this arrangement of cylinders, it will be seen that the top and the bottom ends of the double-acting engine are really two independent single-acting cylinders. The cooling water is introduced in the center of the cylinder base and moves upward through the top cylinder jacket and at the same time downward through the bottom cylinder jacket, regulated at the two outlets with independent valves. The two ends are entirely free to expand from the clamping ring and toward the hot end of the cylinder where combustion takes place, and each cylinder end has its own independent set of ports for air and exhaust.

The top cylinder has one fuel valve, the bottom cylinder two fuel spray-valves furnished with suitable nozzles for directing the jet of fuel-air mixture. The bottom spray valves are so arranged that the charge does not impinge upon the piston rod.

The piston is in a similar way built up of two single acting pistons, each resting on a flange on the piston rod to which it is secured with a number of heavy bolts. The center part of the piston consists of a sleeve in halves, located on the piston rod by recessing, leaving the two ends free to expand. The piston heads, which are of forged steel, are shaped as deflectors on the air side but on the exhaust side are shaped to allow an easy outlet for the escaping gases.

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Fresh water is used for cooling. Sea water, and especially river water, often contains much mud, which, in the cylinder jackets or pistons, produces undesirable results. Sea water will deposit scale on the hot surfaces; it can spoil the oil entirely if mixed with it even in very small amounts; it tends to corrode steel parts and will also attack cast iron. Oil is used often for piston cooling in small engines, principally on account of simplicity, but is not nearly so efficient for cooling as is fresh water. A closed fresh water system for the entire main and auxiliary machinery appears to be the most desirable arangement for efficient cooling, cleanliness of all jacketed spaces, absence of corrosion, open outlet from jackets and pistons, simplicity of the pumping arangement and safeguarding the circulating oil system in which a small amount of fresh water is not harmful since it can be removed through a centrifuge.

The valve motion is designed on conventional lines with one cam for each fuel spray valve. Each valve lever oscillates round an eccentric on the fulcrum shaft, which can be turned through a small angle by hand for reduction of the valve lift at low speed. The cams are symmetrical and can be used for running in both directions by rotating them through an angle of 34 degrees in relation to the main shaft. This is done in the following manner:

A spur gear on the main shaft engages an idler of considerable width, which drives a spur gear wheel keyed on a horizontal lay shaft located in the bedplate in front of the engine. This shaft can slide longitudinally in its bearings and, as the above mentioned spur gears have diagonal teeth, this motion will cause it to rotate through an angle of 34 degrees for the full travel of the lay shaft. The lay shaft passes through a sleeve which is supported in two bearings and follows the rotation of the lay shaft. The cam shaft is driven from a bevel gear bolted to the sleeve by the intermediate vertical shaft and will thereby be displaced the proper angle when the lay shaft slides from one extreme position to the other. To the forward end of the lay shaft is attached, by means of two ball bearings, a piston in the bore of which the lay shaft can freely revolve. This piston travels in a cylinder under oil pressure and is held tight against a face in the one or the other end of the cylinder for either ahead or astern rotation of the engine. Reversing is thus reduced to the turning of a four way cock, admitting oil on one side and allowing oil to escape from the other side of the piston.

This system requires oil under pressure all of the time, and for this reason the following oiling system is employed:

The used lubricating oil is drawn from the bedplate sump by a pump and passed through a strainer and a cooler and delivered to a large storage tank placed in the engine room casing. Lubricating oil for the forced feed system and for the maneuvering gear is taken from this tank some inches above the bottom. This system has advantages compared with the use of a tank in the double bottom, such as independence of leakage of the ship's bottom, steady oil pressure for lubrication, reserve of oil under pressure for maneuvering, easy draining of water from the bottom of the tank to pass through the centrifuge, easy cleaning of the tank. In conversion jobs, it saves shipbuilders' work on the double bottom.

Scavenging air can be supplied to these engines either from a displacement pump, driven most conveniently by the engine itself, or by a turbo blower, driven preferably by a D.C. electric motor directly if obtainable in such speeds, or through gearing.

The unit now built in the Snow-Holly Works at Buffalo, receives its air from a fourth part of a scavenging pump intended for a four-cylinder engine. The efficiency of the scavenging pump is an important factor in the fuel economy and also in the power capacity of the complete engine.

If the valves are of the voluntary type, it is necessary to impart to the whole volume of air an excess pressure for actuating the valves. The displacement of the scavenging pump is 50 per cent in excess of that of the engine itself and each pound of excess pressure on the suction or discharge side of the scavenging piston will absorb 1½ lb. of brake M.E.P. of the engine which is lost as usable h.p.

For this reason it is more advantageous to open and shut the passages for this large volume of slightly compressed air by mechanical power, using a light slide valve correctly timed and opening large passageways for the slowly moving air.

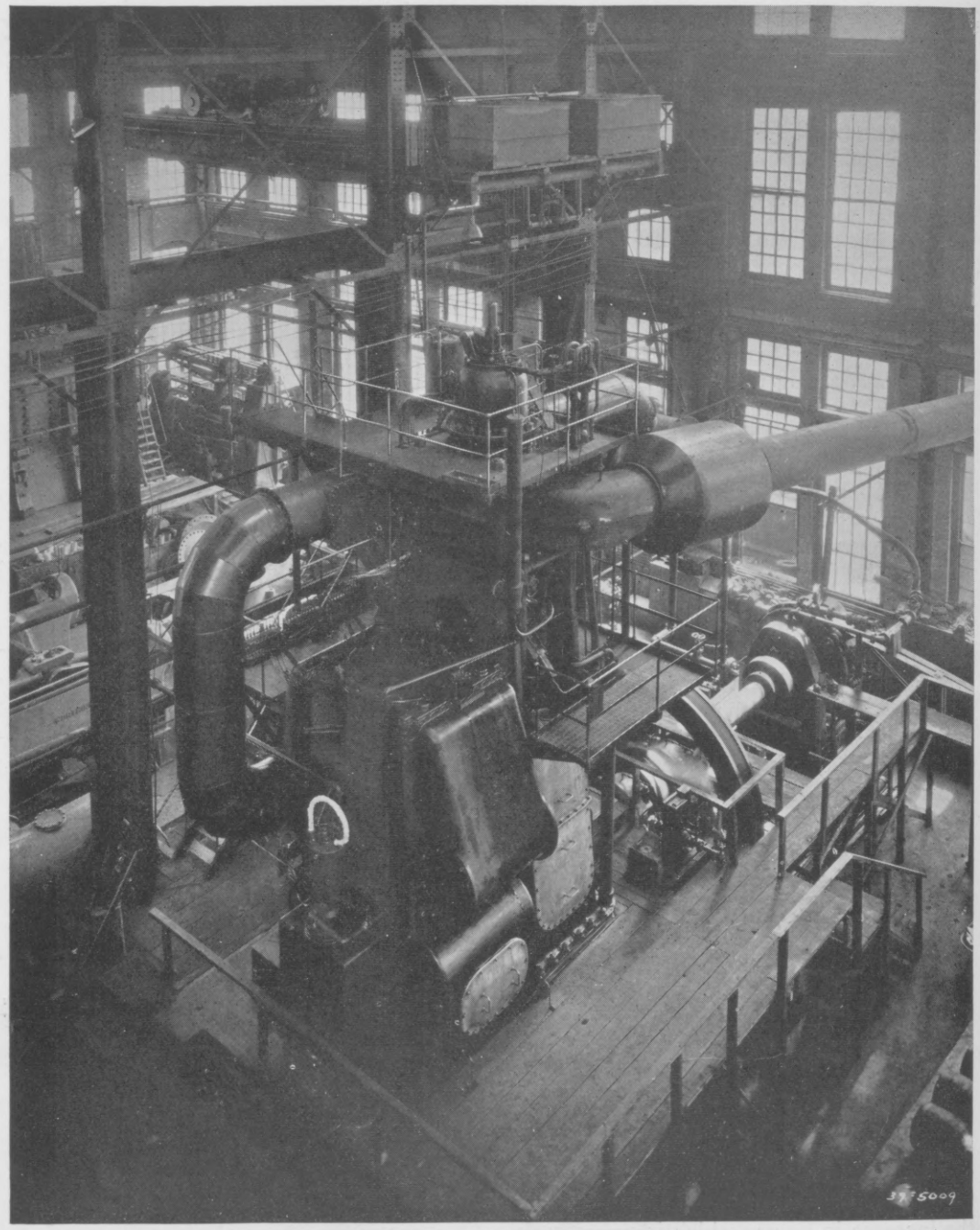

**Illustration made from photograph taken of Worthington double-acting two-cycle engine as set up in the shop for test purposes**

This design has been effected in the scavenging pump illustrated with the main engine.

The power used for scavenging this double acting two-cycle engine is thereby made smaller than usually is absorbed in air resistance during the two scavenging strokes of a four-cycle engine, because the area through the inlet and exhaust valves is limited by the location of these valves in the cylinder head and the actual velocity with which the air passes through these valves is much higher than ordinarily issued in air compressors and very much higher than in reciprocating separate scavenging pumps.

In order to simplify the scavenging air manifold, the pump cylinder is placed at about the same height as the main engine cylinders. The crosshead for the scavenging pump is used also as a single acting piston in the first stage of the spray air compressor; the other three stages are located on the rear side of the engine in a single casing and driven through a beam from the same connecting rod which drives the scavenging air pump.

In such marine installations where it is desired to simplify the pumping arrangement by driving the service pumps from the main engine, this beam can be extended outside of the engine for this purpose.

Some engineers prefer to drive from the main engine all those auxiliaries which are essential to its operation. Circulating water and force feed lubricating oil services would come under this head.

Such an arangement of service pumps will require at sea the operation of the main propelling engine only, with the possible addition of a small electric power set to provide current for steering engine, lighting, etc. This electric set, however, can, if desired, be driven from the propelling engine, and the fluctuations in voltage in the generator due to variations in speed can be eliminated by floating the load on a storage battery. Such practice is followed on certain vessels built in Europe and on the tugboat JUMBO. With the service pump equipment arranged as indicated above, the number of independent auxiliaries is reduced and the whole engine room layout simplified.

The engine of which the foregoing is a single unit will, as stated, consist of four cylinders, each 27 inches diameter by 40 inches stroke, delivering 2,400 shaft horsepower at 90 r.p.m.

This propelling engine is the fruit of many years of engineering and manufacturing experience in building Diesel engines by the Worthington Pump and Machinery Corporation. In developing this design, advantage has been taken of the difficulties met by the builders of Diesel engines all over the world, and to a large degree these difficulties have been eliminated. Calculations as regards weights and costs of production of this design lend much encouragement to the hope that it will go a long way toward overcoming these two large objections to the use of Diesel engines for ship propulsion. These calculations indicate substantial savings, both in weight and in cost, over many single-acting Diesel engines of similar power having similar conservative pressure ratings as those followed in this design. Already a big American shipyard is considering a manufacturing license.

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# Financing Time Payment Sales of Marine Oil Engines

*How Oil Engines Can Be Paid For Out of Their Savings Without Undue Burden on Builder or Buyer*

THE volume of business done in the sale of small marine engines is constantly increasing. Commercial fishermen have found that an oil-engined boat is a better profit maker than one with gasoline engines or no engine at all, tug boat owners are recognizing that the stand-by charges of a steam tug make heavy inroads in their earnings and throughout the country generally the tremendous growth in automobile traffic has created an opportunity for the successful operation of ferries, a type of service into which the oil-engine fits admirably.

Manufacturers of engines of this type should be able to look forward to a steadily rising sales curve, not alone because of new opportunities for the use of their product, but because sales resistance is being gradually lowered. A tremendous amount of educational work has been done since this field was first pioneered in 1916 by Motorship. The marine oil-engine is no longer a thing of mystery surrounded by fear and doubt. Its superior advantages over other types of prime movers in its own sphere are recognized generally.

With the growth of sales, oil-engine manufacturers will be brought face to face with a group of new problems, the successful solution of which will be the gauge of individual success and it seems altogether likely that these will relate in the main to engineering progress and the broader phases of merchandising.

An alert engineering department, open minded and forward looking is a tremendous asset to any oil-engine manufacturer. As rapid as has been the progress of the last eight years there is ample evidence that engine design is still fluid. This situation exacts a painful toll from the builder who knows that he could standardize at a great saving to himself and the engine buyer but at the bottom it makes for the advancement of the business as a whole. One has only to consider the refining process which is still under way in automobile design after twenty years of active production to realize what true progress implies.

Important as engineering is, a sound, effective sales policy is equally necessary to success and it sometimes appears to the onlooker than there are some phases of oil-engine selling which would well be developed, improved, strengthened and simplified. Selling an oil-engine is not exactly like selling the staple artices of commerce, yet there are undoubtedly many principles which are susceptible of application with suitable modifications and there are some agencies which are equally useful.

The problem of what to do with the responsible man who wants to buy an oil-engine but lacks the ready money to pay for it has been a knotty one to many builders and it will be encountered with increasing frequency as business grows.

Conservative builders in their desire to keep their own enterprise on a solid foundation sometimes adopt a policy covering sales of this character which is so rigid that it compells them to turn down much business which is offered to them.

This business may find its way to other manufacturers whose policies are more liberal and there have been cases where the acceptance of a large volume of this business has led to the financial embarrassment of the builder. When such a concern finds that an undue amount of its capital is tied up in a safe full of customers' notes, growth is impeded by a lack of working capital and the ensuing situation is often cited as an argument against encouraging this type of buyer.

There has lately come into use a procedure, which while new in the oil-engine business has long been successfully employed by automobile builders and others who depend for a large volume of their sales upon a class of people who are buying an article which they prefer not to pay for in full at the time of purchase.

Several large investment companies with capital ranging up to twenty million dollars in individual instances have lately developed a plan for financing the sale of oil-engines on time payments, and are actively in the market seeking such business from responsible builders.

The procedure is almost identical with that employed in automobile sales, and while it varies slightly in individual cases is substantially as follows:

The time payment sale price is generally fixed about 6 per cent higher than the cash price to provide for the underwriting charges. The purchaser pays approximately 25 per cent as his cash payment and gives notes extending over a period of two years or less. The manufacturer endorses these notes and receives immediately about 85 per cent of their face value. The notes are assigned as collateral security to the financing company which takes care of all collections. The title of the engine remains in the name of the manufacturer. Hazards are provided against by insurance wherever possible. It is customary to provide that when the purchaser passes a payment, all payments become due if the company elects to demand them. When a total of three or four payments are in default indicating that the purchaser does not intend to complete his contract, the financing company calls on the manufacturer to take over the contract.

The principle objection to the plan from the manufacturer's viewpoint is his necessity of endorsing the paper, yet it is unlikely that any plan will ever be available to protect the builder against this ultimate liability. In answer to this objection, companies making a practice of this business point out that endorsements of this character do not impair the manufacturer's credit standing to the same extent that borrowing money direct would, since such an endorsement is not a direct obligation but a contractural liability, moreover the efficiency of the financing company's collection department makes the possibility of loss to the manufacturer remote.

The plan has many features which appear to recommend it strongly. The financing organization investigates the credit of all applicants for time sales, ridding the builder of this detail. An even more desirable feature is the fact that it makes all collections freeing the manufacturer from an unpleasant duty which sometimes complicates his relationship with his customer. It not frequently happens that a customer who is reluctant to meet his notes sets up ill-founded claims as to the unsatisfactory performance of the engine in order to gain time. Then, too, it has been found that an outside agency making its collections through banks generally receives more business-like treatment than the manufacturer himself.

If some plan of this character comes into general use it will at least have the advantage of putting all manufacturers in the same class on a common basis as far as the accommodation they extend to customers is concerned, making the applicability of the product to the service, in point the deciding factor rather than the amount of credit which will be given.

To prospective users it should render a useful service by enabling them to purchase any oil-engine by a payment down and paying for it out of the economies effected, and thus permit the more rapid expansion of sales along sound financial lines.

## Fire on the Motorship Prometheus

In the Standard Oil Company's magazine, *The Lamp*, for August is a story covering the fire on the Prometheus, which started at midnight on the 13th of July when the vessel was 200 miles off Bermuda, en route from Hamburg in ballast. The fire was discovered to have started in the 'tween decks abaft the engine-room, and all fuel lines to the engine-room were instantly shut off. The starboard engine was stopped and the port engine was turning slowly with the vessel heading to the wind.

Soon the fuel in the settling tanks was afire and several explosions occurred blowing out the bulkheads into the main engine-room. Then the fire started in earnest. Repeated explosions occurred and the fire increased until the after end of the ship was in flames. Fortunately, the flames did not reach beyond the forward end of the bulkhead of the engine-room, separating the cofferdam between that and the main fuel tanks. In the afternoon the fire gradually subsided and by evening it was almost out in the engine-room, but the refrigerator, galley-coal bunker and adjacent rooms were still burning. By the afternoon of the 15th the fire was extinguished.

The British tanker Inverarder had been standing by rendering assistance since three hours after the fire started until the fire was out. On the 17th the S.S. Benjamin Brewster arrived with stores and towed the ship to the Ambrose Light.

Mute testimony is given of the appalling heat by the twisted beams of the engine-room and deck; the steel beams sagged and metal rails twisted beyond repair. It is fortunate that the fire was confined to the after part of the ship, and was not due in any way to the Diesel engines.

As a matter of fact, machinery of this type constitutes less of a fire hazard than an oil-fired steam plant. At no point on the engine or exhaust pipe is there an open flame comparable to that of a boiler furnace.

It is probable that the vessel will be loaded with cargo and towed to Germany for reconditioning and for the installation of new Diesel engines. Bids have been secured from New York repair yards.

The Prometheus is of 14,000 tons d.w. and is propelled by twin four-cycle Krupp Diesel engines of 2,000 i.h.p. each.

## British Coasters

"British Coasters" is the name of a special ship registry that lists in convenient ways ships between 100 and 1,000 tons gross trading in the waters surrounding the British Isles. The major part of the book lists the vessels according to their owners, whose names appear in alphabetical order. General service vessels are marked (A) or (M) according to whether they have auxiliary or main oil engine power, whereas tugs and salvage craft, which are also included, are not thus characterized. Cross-listings include an alphabetical list of the names of the vessels, a classification into tonnage groups, and into horsepower groups. The register is compiled by F. J. N. Wedge and Frank C. Bowen and is published by Sampson Low, Marston & Company, Ltd., London.

## A Shipping Exhibition

A shipping, engineering and machinery exhibition will be held at Olympia, London, from November 23rd to December 5th, 1925 under the management of Frederic W. Bridges, who has managed the previous exhibition of this series. On the occasion of the last exhibition Frederick D. Herbert, President of the Kearfott Engineering Co., New York City at a banquet expressed the hope that an opportunity could be afforded to American concerns to participate in the next one. Mr. Bridges advises us that the Exhibition Committee will be delighted to have a thoroughly representative American display and have decided to devote a portion of the building to American Section. Mr. Bridges will be in the United States this fall.

The Mitsubishi Zosen K.K. of Nagaskai, Japan, have acquired a Sulzer Diesel license and are building two 2,300-s.h.p. engines for one of three passenger-cargo motorships for the Osaka Shosen K.K. referred to elsewhere in this issue.

Three large twin-screw passenger-cargo motorships are building at the Mitsubishi Zosen K.K.'s yard at Nagasaki, Japan, for the Osaki Shosen K.K. of Osaka, in which two 2,300 s.h.p. at 112 r.p.m. Sulzer Diesels are to be installed per boat. Two of the engines are being constructed under license by the builders of the hull, and four engines are under erection at Sulzer's plant, Winterthur, Switzerland.

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# Our Readers' Opinion

*(The publication of letters does not necessarily imply Editorial endorsement of opinions expressed)*

## Standard Oil Co. on the Diesel Fuel Supply and Cost in the Future

*To the Editor of* MOTORSHIP:

Referring to your quotation in August of Lord Kylsant's fear regarding general utilization of Diesel-engine powered vessels, it would appear to us an producers and refiners that predictions as to the source of petroleum supply and prices over a large period in the future are always hazardous on account of the great variation from time to time in both supply and demand.

We believe that the first consideration as to the advantages or disadvantages of motor-driven ships should be based largely upon the trade route over which the vessel is designated to be operated by the owners. It has been conclusively proven that Diesel powered ships show up to much greater advantage and offer much more saving when operated over long trade routes. The cost per ton mile, which is the important factor to any steamship owner or operator, is materially towered as the route is lengthened.

There is another consideration that will always play an important part in the cost of operation of Diesel motor-vessels, viz., whether these vessels are operated over trade routes touching ports-of-call, either at the source of supply of crude oil or some oil field producing a grade of oil in quantities large enough to insure the ship-owner a supply at reasonable prices. We believe that Lord Kylsant is aware that the cost of petroleum products rises very rapidly when it is necessary to ransport them from their source of supply to distant ports.

Due to America's tremendous production of crude oils suitable for the manufacture of Diesel fuel-oil of characteristics as known today, prices for this oil have been cheapest at American ports, either Atlantic, Gulf or Pacific. This has, of course, been due to close proximity of these ports to prolific and producing areas, together with refineries advantageously located for the economical delivery and transportation of crude oils either by pipe-line, water, or a combination of both.

On the other hand, these localities may change over a comparatively short time, due to diminution of the producing wells in that particular locality, or discovery of new fields in other localities. Unfortunately, crude oil cannot be produced under the more or less certain conditions that govern mining operations, such as coal or iron where the deposits and extent of the deposits are well-known and fairly stable. On the contrary, flush petroleum pools are discovered from time to time at widely different locations. These properties may also be frequently held by numerous owners with the result that intensive drilling takes place to recover the deposit of oil before it is drained by wells adjoining the owners. The result is self-evident. More production takes place, petroleum products are thrown on the market regardless of the demand.

We believe this factor more than any other is the cause for the extreme fluctuation in the price of Diesel fuel-oil for the past decade, and the same will hold true to some extent, we believe, in the future. During these periods of flush production, the larger refiners make every effort to store crude oil. The cost, however, of erecting storage and carrying large stocks of crude or petroleum products is very heavy and there is naturally a limit to the amount of crude that can be financed and carried in storage.

We also believe that the prices which are governed by the supply of what is now known as Bunker fuel-oil, or perhaps more commonly known as Bunker "C" oil which is utilized for generating steam under boilers both for marine and shore purposes, will affect the cost to the owner and operator of Diesel powered vessels. It has been estimated that roughly 450,000,000 barrels of fuel-oil was used in the United States during the year 1923—possibly two-thirds of this amount of the specifications commonly known as Bunker "C" fuel-oil. Of this amount, railroads in the United States consumed approximately 45,000,000 barrels; merchant vessels 52,000,000 barrels; United States Navy 6,000,000 barrels and shore plan industries 125,000,000 barrels burned under boilers for generating power.

If the price of bituminous coal decreases continually as it has been for the past six months or more, and the price of heavy fuel-oil remains the same, or should increase due to diminution in production of asphaltic-base crudes, from which this fuel is made, it will be cheaper for the railroads and shore plants, at least in the great majority of cases to convert back and use coal as a fuel. This will also be true for marine work, with the possible exception of passenger liners or specialized freighters running over well-defined trade routes.

This will leave quite a large proportion of fuel-oil suitable through various advanced refining processes to be converted into oils suitable for Diesel engine use which will tend to balance or average out the price of Diesel fuel-oil, due to removing from market a large volume of crude which has been converted to Bunker "C" fuel for the use of oil-firing under boilers. This is a reasonable assurance that the price of suitable fuel will not go above a level where the Diesel engine can favorably compete against coal-burning steam machinery, and at the same time insure that there will be no shortage in the future of suitable fuels for oil engines. This together with the consideration of the efficiency of the Diesel engine in making the most economical use of oil known today can be applied to a very considerable part of present ship operations. Roughly, the modern marine Diesel engine consumes about one-third of the amount of oil that would be consumed by an oil-burning steam-driven ship of comparable tonnage and horsepower. Hence every million horsepower in steam changing from oil burning to coal burning will make available enough oil fuel for three million Diesel horsepower. If we compare the advantages of a Diesel engined ship with that of a coal-burning steamship, the advantages are, of course, still greater.

There is one very important factor which we believe should be brought forcibly and clearly to the minds of marine engineers in designing the Diesel engine of the future. Diesel engines today have been perfected to burn economically Diesel fuel-oil which is a distillate product made from either American paraffine base crudes or crudes found elsewhere of similar characteristics—the result being a specialized product which is not obtainable at all bunker ports throughout the world where Bunker "C" fuel-oil, a residual product, may be had. With the advance in refinery processes, Diesel oil today is being utilized and broken up into making gasoline and other light products for which there is an ever increasing demand.

Should industries convert back to coal due to the cheapness of this fuel as against heavy fuel-oil to any appreciable extent, the oil left by this condition could be worked into a fuel suitable for Diesel engines. In the future it may become necessary for refiners to cut deeper and deeper into available crudes and the characteristics of the oil left for Diesel use will be changed from that which is now specified as Diesel fuel oil. In other words, Diesel engines should be perfected to utilize an oil which is stock-in-trade and is a product that can be had at all times at the cheapest prices for combustion use.

We realize that the manufacturers of Diesel engines today have invested millions of dollars in patents, dies, machinery, etc., for the manufacture of Diesel engines as sold at present and naturally it is a momentous undertaking for them to scrap or revolutionize their plants for the manufacture of an entirely different type of motor. However, a Diesel engine can be operated so economically and due to its construction can burn almost any product containing a high percentage of carbon provided, of course, that this product can be injected efficiently into the cylinder.

With the utilization of heavier fuels similar to Bunker "C" fuel-oil, it will be necessary for the manufacturers of Diesel engines to change the valves and method of injection of the Diesel engine. Also important changes will have to be made in the size of the piping delivering the fuel to the engine. Heavy oils, unlike the present day Diesel fuel-oil, cannot be expected to gravitate to the cylinder. It will be necessary to pre-heat the oil both in the storage tanks of the vessel to insure efficient handling and pumping, and also to lower the viscosity sufficiently to inject into the cylinder of the motor. Shipowners may possibly say that with the additional heat required and additional equipment on board a vessel to handle much heavier fuel-oils for Diesel use, the cost will mount rapidly. We do not entirely agree with these contentions inasmuch as somewhat the same situation was present at the time when oil began to be burned under boilers in steamships. Early oil-burning steam vessels utilized a light fuel-oil which was procurable at reasonable prices at that stage of the game. When it became necessary to burn heavier products it was necessary to install heater coils in double bottom tanks, high-pressure burning system, etc. This apparatus naturally cost the ship-owner more, but was more than counter-balanced by the reduced price of the heavier grade of fuel-oil. The same simile faces the Diesel-engine manufacturer and operator and the motorship owner today and will be increasingly prevalent in the future.

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[Heating and burning heavy bunker-fuel oils now offer no real difficulty for motorships, and it has been successfully demonstrated both in land power-plants and in sea-going ships that the waste exhaust-gases can be utilized for the purpose. Recently great strides have been made with centrifugal separators in the removal of foreign matter, water, etc., from the heaviest of oils, and at least one manufacturer has produced satisfactory a gas-tight centrifuging device enabling the oil to be heated to 160-200 degrees when necessary. Under this condition the oil flows freely and can easily be handled for purification and for pumping to the engine injection valves. We believe that in a year or so centrifugal treatment of fuel will be standardized on every single motorship, enabling her to bunker and burn—with complete reliability and with low maintainance charges—any grade of oil stocked anywhere in the world.—*Editor.*]

## Conversion of Tanker "Allentown" to Diesel-Electric Power

In a previous issue we referred to the forthcoming conversion of the Atlantic Refining Company's tanker J. W. VAN DYKE. This boat was formerly the ALLENTOWN and was recently purchased for conversion purposes from the Shipping Board. For the conversion of this vessel three 840 b.h.p. Ingersoll-Rand oil-engines and Westinghouse electric equipment have been ordered.

A preliminary article on the conversion of this ship was prepared last month by this magazine, but at a request from the owners its was held over because of some changes in the plans. So the story will not appear until a later date.

The present plans of the Atlantic Refining Company incorporate the conversion of two tankers, the ALLENTOWN and the ANAHUAC, and the construction of three tugs; the first two of which were recently placed in service. All five vessels have Diesel-electric drive. In the ANAHUAC, as well as in the tugs, the Ingersoll-Rand oil-engines are of 225 b.h.p. each, there being two per boat.

The ALLENTOWN, EX.J. W. VAN DYKE, was built by Pusey & Jones in 1918 and is of 7,057 tons d.w.c. At present she has a G. E. turbine and four water-tube boilers.

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The problem of converting the various steam-driven river vessels operated by the United States Inland Waterways Corp. to oil-engine power is being given very serious consideration by the Advisory Board to the War Department, and it is very probable that some of the boats will be converted in the future. Conversion work has been postponed and will probably be postponed for some time on account of lack of funds.

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